MUSICAL MOOD INDUCTION AND ITS EFFECTS ON ANALOGICAL REASONING

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DEDICATION

This thesis is dedicated to the memory of both my “Nonie”, Mary Christine Hern McLean Wise, and my “Papaw”, Kary Wayne McIntyre—both of whom had a profound influence upon my life, and both of whom encouraged and supported me along my path to this academic milestone (as well as in innumerable extracurricular endeavors). Additionally, this thesis is dedicated to my mother, Kimberly McIntyre Johnston, to my “Mamaw”, Marsha Dianne McIntyre, and to my significant other, James “Adam” Isaac. Without their never-ending support, guidance, encouragement, and love, I would never have succeeded in my academic endeavors thus far, and I would never be within such a short reach of realizing my dreams.

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ABSTRACT

Christian Dianne Johnston

Musical Mood Induction and its Effects
on Analogical Reasoning

(Major Professor: Jack A. Palmer, Ph.D.)

Music moves us: it has been described as the “language of emotions”. In this study, the researcher aimed to determine whether musically-induced mood has an effect on an individual’s level of performance on a measure of analogical reasoning through the utilization of the Vieillard et al. (2008) emotional musical excerpts. Furthermore, the researcher examined Eysenck’s neuroticism and psychoticism personality traits as potential factors influencing this proposed relationship. Participants in this study were 173 undergraduate students enrolled in undergraduate psychology courses at The University of Louisiana at Monroe (ULM). Following repeated measures analyses, results indicated that musically-induced mood significantly affected performance on the analogy task. Additionally, results indicated that individuals scoring high in Eysenck’s psychoticism were generally less affected by the emotionally-charged stimuli. Potential avenues for further research were discussed.

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LIST OF ABBREVIATIONS

ANOVA	Analysis of Variance
APA	American Psychological Association
ARAS	Ascending Reticular Activating System
BA	Brodmann Area
BDI	Beck Depression Inventory
E	Extraversion on the Eysenck Personality Questionnaire Revised Short Scale
EPQ	Eysenck Personality Questionnaire
EPQ-R	Eysenck Personality Questionnaire Revised
EPQ-R-A	Eysenck Personality Questionnaire Revised Abbreviated
EPQ-R-S	Eysenck Personality Questionnaire Revised Short Scale
fMRI	Functional Magnetic Resonance Imaging
IDS	Infant Directed Speech
IRB	Institutional Review Board
MAT	Miller Analogies Test
MRI	Magnetic Resonance Imaging
N	Neuroticism on the Eysenck Personality Questionnaire Revised Short Scale
P	Psychoticism on the Eysenck Personality Questionnaire Revised Short Scale
PA	Public Address (System)
PANAS	Positive and Negative Affective Schedule
PET	Positron Emission Tomography
SDFMS	Semantic Differential Feeling and Mood Scale

SPSS	Statistical Package for the Social Sciences
ULM	University of Louisiana at Monroe
VB	Visceral Brain

LIST OF SYMBOLS

n	Number in a subsample
Λ	Lambda; Wilks' multivariate criterion
F	Fisher's *F* ratio
p	Probability; the probability that a given effect is due to chance
η^2	Eta squared; measure of the strength of a relationship
M	Mean
SD	Standard deviation

INTRODUCTION

"Our life begins with a lullaby, matures with a wedding march and ends in funeral music" (Wang, 2015, p. 1). Music moves us: it has long been an important component of most—if not all—cultures across time and is an integral part of the lives of individuals throughout the world. It exists universally across human history and culture (Conard, Malina, & Münzel, 2009; d'Errico et al., 2003; Wang, 2015). Most cultures across the globe utilize some form of musical behavior to celebrate, worship, congratulate, or simply to entertain.

By six months in age, an individual has developed the capacity to distinguish between music expressing happy and sad emotion (Flom, Gentile, & Pick, 2008) and has developed a preference for consonant (rather than dissonant) music (Zentner & Kagan, 1998). By the age of six years, the individual likely has memorized more simple musical pieces with familiar melodies (such as the "Alphabet Song" or "Twinkle Twinkle Little Star") and has begun utilizing adult-like procedures of determining potential emotional meaning in music (Peretz, 2001). By sixteen, the individual has likely utilized music to relax and unwind, to garner excitement before a "big game", self-medicate, or even simply to relate to others. Music follows a growing individual throughout his or her lifetime—acting as a soundtrack to one's life. Music's grip on society is too powerful for human fascination with music to be explained by chance alone: most researchers would likely concur that there is something inherent within the human species which inclines humans to demonstrate musical behaviors. While some are simply content listening to or

creating music—some researchers are, in fact, intrigued by the potential reasons for music's pervasive prevalence across cultures and time.

Not only has music earned a place in the everyday lives of many individuals, research indicates that music possesses the ability to profoundly affect human brain activity and bodily responses (Bade, Bade, Hoerres, & Kremsreiter, 2012). Psychological effects of music listening are well-documented in literature in a variety of fields, including (but certainly not limited to) the ability to reduce stress, anxiety, and arousal (Labbé, Schmidt, Babin, & Pharr, 2007), the ability to decrease heart rate following aerobic exercise (Jing & Xudong, 2008), and the ability to reduce the occurrence of sleeping disturbances such as insomnia (Harmat, Takács, & Bódizs, 2008). Additionally, the discipline of musical therapy have been shown to be effective in the reduction of various maladaptive symptoms (e.g. depression, pain; Bade et al., 2012).

General background music has been demonstrated as possessing the ability to increase such cognitive aspects as linguistic processing and spatial reasoning, suggesting background music may have an effect (albeit a currently unpredictable effect) on an individual's cognitive performance (Angel, Polzella, & Elvers, 2010). Music listening has become an immensely common behavior while an individual is studying, working, exercising, or simply relaxing, especially with the surge in online music provision services (Bade et al., 2012). It has been suggested that listening to music may play many roles in the context of such tasks, such as masking ambient noise, increasing attention, and reduction of boredom (Hargreaves & North, 1997). There does not exist an expansive body of literature regarding the effects of music on an individual's ability to reason; however, musical training in childhood has been demonstrated as effective in enhancing

verbal abilities, nonverbal reasoning, and general reading skills (Forgeard, Winner, Norton, & Schlaug, 2008; Miendlarzewska & Trost, 2014).

Music has even been described as the "language of emotions" (Cooke, 1959; Juslin, 2013b). Many would likely agree that music possesses the ability to affect an individual's emotions and mood in a manner that neither books, art, nor films can equal (Stubing, 2012). Few researchers would argue the claim that music is commonly perceived by listeners as expressive of emotions. Expression of emotion has generally been considered to be one of the most vital criteria for the aesthetic value of music (Juslin, 2013a; Juslin, 2013b).

However, researchers have oftentimes utilized widely varied stimuli, dependent measures, and methodology and, therefore, little research exists regarding the potential effects of music on various measures of task performance. Due to all the variance in the studies related to this topic, Day, Lin, Huang, and Chuang (2009) suggested that one should not be surprised by conflicting results; the researchers recommended more controlled studies to reduce variance. The research of Vieillard, Peretz, Gosselin, Khalfa, Gagnon, & Bouchard (2008) attempted to address one specific facet of this inconsistency in methodology through the development of a set of normed stimuli for use in music-based emotion research. Fifty-six musical excerpts were divided into four groups of fourteen clips intended to evoke a differing emotion (i.e. happy, sad, peaceful, scary). Vieillard et al. (2008) conducted a study to test the ability of participants to correctly recognize and identify the intended emotion within the developed musical clips, and, interestingly, participants more commonly correctly recognized and identified the intended emotion within the musical clips when instructed to focus upon their own

experience. Furthermore, studies conducted by Hill (2009) and Hill and Palmer (2010) provide strong support for the Vieillard et al. (2008) musical excerpts as normed musical stimuli in musically-induced mood research in attempt to better organize research on musically-induced mood.

This researcher aimed to expand upon the existing literature regarding the effects of music listening on an individual's ability to perform on a specific cognitive task—in this study, whether musically-induced mood has the ability to affect an individual's ability to perform on a measure of analogical reasoning (i.e. word analogies) through the utilization of the Vieillard et al. (2008) musical excerpts. It was hypothesized that the four emotions (e.g. happy, sad, peaceful, and scary) would demonstrate an effect on ability to perform that differs from the control (e.g. white noise); furthermore, it was hypothesized that the differing emotions would demonstrate differing effects on participants' ability to perform on the cognitive task. Specifically—in reference to the various emotions—it was hypothesized that the "happy" music would facilitate increased ability to perform on a measure of analogical reasoning and critical reading (in this research, measured through ability to correctly respond to word analogies, each with an incomplete word pair). Conversely, it was hypothesized that the "sad" music excerpt would facilitate *decreased* ability on the same measure (within-subjects). This is because sadness and depression are adaptive responses associated with psychological withdrawal as a protective mechanism and a lowered physiological tempo to conserve energy (Palmer & Palmer, 2002). Regarding the less-extensively studied musically-induced emotions of "peaceful" and "scary", it was hypothesized that the reduced state of arousal associated with relaxing (i.e. "peaceful") music would elicit decreased performance on

the analogical reasoning task. On the other hand, the heightened state of arousal associated with the "scary" music was hypothesized to *increase* participants' ability to perform.

Additionally, this researcher explored the potential effects of Eysenck's neuroticism and psychoticism (as measured by the EPQ-R-S) personality traits on participants' ability to perform on the analogical reasoning task (i.e. word analogies) through their proposed relation to the strength of an individual's reactions to emotionally-charged stimuli. In response to Hill's (2009) finding that individuals scoring high on Eysenck's neuroticism scale exhibited a tendency to be more severely affected by the emotionally-aligned musical excerpts by Vieillard et al. (2008), it was hypothesized in this study that participants who reported high scores on the neuroticism scale would be more affected by the mood-inducing stimuli, and this enhanced emotional response would, thus, exert a greater effect on their ability to perform on the cognitive task (as compared to individuals scoring low on the neuroticism scale). Furthermore, in response to the characterization of individuals scoring high on Eysenck's psychoticism scale as being "toughminded", cold, and unemotional, it was hypothesized that participants reporting high scores on the psychoticism scale would be less affected by the mood-inducing stimuli, and, therefore, the mood-inducing stimuli would exert a lesser effect on their ability to perform on the cognitive task (as compared to individuals scoring low on the psychoticism scale).

Defining Music

What, exactly, is to be considered "music"—in other words, how is one to define the term? This is a question that should, perhaps, have an answer which is simplistic in

nature; however, dictionary contributors, authors, and researchers have, instead, found the defining of music to be a task that is daunting in nature. What some may consider to be music, others may consider to be random, seemingly-meaningless noise. When one attempts to define a term, one likely first turns to one's dictionary (or, in today's culture, an online dictionary), but dictionary definitions are complex, numerous, and vary in the aspects on which they focus, providing no singular, universally accepted definition. For example, first consider the Merriam-Webster Dictionary's first definition of music (online; one of many definitions): "the science or art of ordering tones or sounds in succession, in combination, and in temporal relationships to produce a composition having unity and continuity" (Music [Def. 1a], n.d.). The Oxford English Dictionary, on the other hand, defines the term as "vocal or instrumental sounds (or both) combined in such a way as to produce beauty of form, harmony, and expression of emotion" (Music [Def. 1], n.d.) or as "a sound perceived as pleasingly harmonious" (Music [Def. 1.2]. n.d.). These definitions may "make sense" to many, but they are inarguably imprecise, and terms such as "unity" and "pleasure" can be subjective—what one individual may perceive as unified and pleasurable, another may find jumbled, confusing, or obnoxious.

Researchers have also defined the term "music" in a wide variety of manners, but they are, at least, somewhat more succinct, and *most* rely upon non-subjective terminology. Blacking defined his perception of the term as "organized sound into a socially acceptable pattern" (1995) and as "humanly organized sound" (1973). This definition is certainly more succinct and omits the most subjective of terms commonly utilized in dictionary definitions; however, it presents another issue: what, exactly, is "socially acceptable"? Music, its arrangements, and the instruments used to create it vary

from culture to culture—oftentimes profoundly—thus, what is considered "socially acceptable" in one culture may not necessarily be seen as "socially acceptable" in other cultures. Obviously, the defining of such a subjective term is a difficult task. This author utilized the definition presented by ethnomusicologist Bruno Nettl, who defined music as "human sound communication outside the scope of a spoken language" (2015, p. 29). This definition has also been accepted by Mithen (2006, p. 11) and provided the possibility of including a diverse variety of sounds and musical practices (Nettl, 2015), encompassing the idea that music varies from culture to culture (Mithen, 2006).

Elements of music. Fortunately—despite the multiplicity of definitions provided for the term "music"—there exist, at the least, a handful of basic musical elements which are uniform across most music variations and utilizations; these are the lower-order musical concepts known as pitch, loudness, timbre, rhythm (i.e. duration), tempo, contour, spatial location, and reverberation (Levitin, 2006). Of course, some researchers (and, certainly, those of a musical inclination) would argue that a list of such musical elements should be more comprehensive, including other such elements as phrasing, form, harmony, and those which many find more difficult to define (e.g. breaks, contrasts, etc.); however, a number of these elements necessitate thorough, intensive discussion, and many of these elements are oftentimes considered to *not* be universal (i.e. not all musical elements are utilized in any specific musical experience; Kühl, 2008). For the purpose of this writing, therefore, only the aforementioned universal lower-order concepts will be considered.

Pitch is considered a primary auditory sensation (along with loudness and timbre) and is an integral component of music (as well as speech); specifically, in music,

sequences and combinations of varying pitch are central in defining other musical concepts such as melody and harmony (Oxenham, 2012). Pitch is the "physical correlate" of acoustic periodicity (i.e. repetition rate of an acoustic waveform) and is a main dimension along which sound is varied in musical compositions (McDermott & Oxenham, 2008). Levitin described pitch as "a psychological construct, related both to the actual frequency of a particular tone and to its relative position in the musical scale" (2006, p. 15). Loudness is a familiar, though not well-understood concept. The Harvard Dictionary of Music defines loudness as "the perceived characteristic of a sound that is a function of its intensity, i.e., of the physical energy that the sounding body transmits" (Randel, 2003, p. 473). Thus, in the context of music, it is the amount of energy transmitted by the musical instrument. Timbre—referred to by many as the "color" of sound—serves to allow individuals to determine the source of a sound; it is critical in the recognition of specific sounds (Patil, Pressnitzer, Shamma, & Elhilali, 2012). Naturally, timbre is important in a variety of everyday contexts: for example, in identifying a species of animal by its call or recognizing a family member or friend's voice over the telephone. In the context of music, it is the attribute that allows the listener to distinguish between sounds having the same rhythm, loudness, and pitch (Patil et al., 2012); it is the attribute of an instrument's sound which allows the listener to distinguish the instrument from another (Levitin, 2006)— timbre is different between, say, the flute and the clarinet, and, thus, the individual is able to distinguish the two instruments.

Rhythm and tempo are also familiar concepts to most. Rhythm is the dimension of music which organizes sounds in sequences, and, thus, into recognizable, meaningful patterns (Thaut, 2005). It refers to both the durations of sequential notes, as well as to the

way these notes are grouped into units (Levitin, 2006); without rhythm, musical symbols found in sheet music would have little significance. In such a way, rhythm is a critical role in conveying “meaning” in music (Thaut, 2005). Tempo is generally described as the overall pace (i.e. speed) of a musical piece (Levitin, 2006). While tempo is, indeed, a simplistic concept by nature, its effects have not mirrored this simplicity in musically-driven research. In fact, some researchers (e.g. Katagiri, 2009; Rigg, 1964; Ting & Kartpagam, 2009) suggested that the tempo of music is the primary and most important musical element in determining individuals’ emotional responses to music. Individuals are commonly able to recognize minute differences in musical tempo and can recall tempo over extended periods of time (Brodsky, 2005).

Contour—in both music and speech—describes the “shape” of the musical piece (or verbal statement) and is dependent upon the direction of changes in pitch (but not by specific pitch relationships; Zatorre & Baum, 2012). In other words, contour refers to the pattern of “ups and downs” of pitch in a musical piece (i.e. whether the note following a previous note goes up or down), but not the extent to which it changes (Levitin, 2006). It plays a pivotal role in one’s perception of music—information regarding contour is easily remembered and is particularly perceptually salient (Zatorre & Baum, 2012). Spatial location is simply a term to describe the location from which the sound emanates. Finally, reverberation is the element of music to which most are referring when using the word “echo” in a musical context. It refers to how distant the source of a sound is from the listener, as well as the largeness (or smallness) of the location in which the sound is being produced (Levitin, 2006). It is the quality of music that relates to the difference in the

sound of the music in a large performance hall versus the sound of the music in one's home.

Each of the aforementioned elements of music can also be considered dimensions, as they can be thought of as separate entities, allowing for the scientific study of just one of these dimensions in a particular study. Additionally, each dimension (i.e. element) of music can be varied without the alteration of any other dimension: for example, a musician can change tempo or pitch without affecting loudness or reverberation; one can switch instruments (thus changing the timbre) without affecting contour, and, of course—assuming the musician has not moved from one position to another—spatial location would remain unchanged. These basic elements are integral to understanding music: it is the multitude of combinations of these musical elements and their relations which separate *music* from disordered or random noise. As these elements combine and form relationships, meaning arises—thus giving rise to higher-order musical concepts such as key, melody, harmony, and meter (Levitin, 2006).

LITERATURE REVIEW

Neuroanatomical Considerations

Questions related to the conscious awareness of humans have fascinated scientists and the celebrated "thinkers" as far back in time as records of such ponderings have been created. Such questions have plagued researchers in a multitude of scientific fields, including those such as philosophy, evolutionary biology, anthropology, and, of course, psychology. With the surge of interest in biological avenues of study (as related to other fields), researchers in the field of psychology have had a growing interest in the understanding of the biological bases of various mental phenomena. Thus, a new specialization in psychology emerged—*cognitive neuroscience*. Cognitive neuroscience is grounded in methods of neuroscience, and, while it does not concern itself *only* with questions related to consciousness and awareness, its primary focus is the localization of function of brain structures.

As described by Postle, localization of function is the idea that "different aspects of brain function such as … the control of our emotions vs. our talents as musicians, are governed by, and therefore localizable to, different "centers" in the brain" (2015, p.8). The study and understanding of such localization carries substantial value: not only can such knowledge aid in the understanding of the organization of processing, but also in predicting potential deficits that may arise with damage to specific brain areas (Berman, Jonides, & Nee, 2006). An integral asset to the field of cognitive neuroscience—and to the study of localization of function—has been the development of such medical

technology as magnetic resonance imaging (MRI), positron emission tomography (PET), and functional magnetic resonance imaging (fMRI). An example of the use of medical technology (in this case, fMRI) can be found in a study conducted by Downing, Jiang, Shuman, and Kanwisher (2001). Downing and colleagues wished to determine whether object recognition activated the same general areas of the brain regardless of the type of object being recognized. The researchers were specifically concerned with "mapping" the areas of the brain that are responsible for recognition of the human body and its parts. This is, of course, but one example of the use of fMRI in psychological research; in fact, a multitude of research studies in cognitive neuroscience examine regions of the brain that become active throughout the completion of everyday tasks such as writing one's name, or, in the context of this writing, playing a musical instrument (e.g. Koelsch, Fritz, Schulze, Alsop, & Schlaug, 2005; Limb & Braun, 2008; Phan, Wager, Taylor, & Liberzon, 2002).

Localization of function and musical activity. Of course, while introductory textbooks and things of that nature may make overly generalized, vague statements about the functions of various regions of the brain, human behavior is remarkably complex and should not be subjected to such generalized statements. In truth, though the human brain has, in fact, been shown to have some form of regional differentiation of function, complex attributes such as personality are distributed throughout the brain, and complex behaviors such as the playing of a musical composition involve multiple regions of the brain (Levitin, 2006). In spite of this, there has long been the misinformed idea that music is processed *only* in areas located on the right side of the brain *or* that there is a specific "music center" in the brain. Of course, neither of these statements are correct, despite

their longstanding popularity. In fact, it is now known that activities of a musical nature involve multiple (if not nearly all) regions of the human brain, as well as nearly all neural subsystems. Musical experiences are "multimodal"—they involve (at least) the visual, auditory, affective, motor, and memory systems (Hodges, 2002). Various aspects of music are processed by different regions—the brain is known to utilize "functional segregation" for the processing of music (Levitin, 2006). While a discussion regarding the assignment of some musical functions to specific regions of the brain will be hereafter presented, it is important to recognize and that researchers have only just begun to map and understand these "musical pathways" of the brain.

Music listening. Listening to music involves a multitude of structures in the brain, including subcortical structures (e.g. the cerebellum, cochlear nuclei, and brain stem) and, of course, the auditory cortices on either side of the brain. Pereira, Teixeira, Figueiredo, Xavier, Castro, and Brattico (2011) documented a wide variety of fMRI-demonstrated activations when listening to music (as compared to a baseline condition consisting of unfamiliar Morse Code): extensive activations were demonstrated bilaterally along the superior temporal gyrus, superior frontal gyrus, and supplementary motor cortex; in the left hemisphere, activations were demonstrated in the supramarginal gyrus and planum temporale. Additionally, activations were also observed in structures involved in the limbic and reward systems—specifically, the amygdala, nucleus accumbens, caudate, anterior cingulate cortex, hippocampus, and parahippocampal gyrus.

Keeping time with the rhythm of a particular musical piece involves the utilization of the cerebellum's timing circuits (Levitin, 2006). The traditional view of cerebellar function has been primarily focused on motor coordination (i.e. the control of

complex movements, multi-joint movements, etc.; Kawashima et al., 2000); however, as technology has advanced, this traditional view has expanded to involve many more functions such as motor skill acquisition, the planning of movement, and various cognitive or sensory discrimination tasks (Hutchinson, Lee, Gaab, & Schlaug, 2003). Additionally—although its exact roles are not entirely clear—the cerebellum has also been shown to be involved in auditory processing (Lega, Vecchi, D'Angelo, & Cattaneo, 2016). The primary focus of research relating the cerebellum to aspects of musical perception has been on the cerebellum's vital role in timing (e.g. foot or finger tapping or otherwise keeping time with a rhythm; Kawashima et al., 2000)—a focus that certainly seems intuitive, considering the cerebellum's well-documented role in movement and the planning of movements.

Menon and Levitin (2005) mapped the activation of various regions in the brain when listening to music in great detail. Levitin (2006) summarized this information quite efficiently. First, the auditory cortex was activated in preliminary processing the components of the sound. Second, frontal regions of the brain (e.g. BA44 and BA47) previously noted as involved in the processing of musical structure and expectations associated with it are activated. Finally, regions of the mesolimbic system (which is involved in arousal, pleasure, and the production of dopamine) are activated, culminating in the activation of the nucleus accumbens. Additionally, the cerebellum and basal ganglia were activated throughout the music listening—this is assumed to support the processing of rhythm and meter. Thus, the reward and reinforcement aspects of music listening seem to be "mediated by increasing dopamine levels in the nucleus accumbens,

and by the cerebellum's contribution to regulating emotion through its connections to the frontal lobe and limbic system" (Levitin, 2006, p. 191).

Following along with music that is recognizable or that is, at least, performed in a style with which one is familiar involves additional regions of the brain, including the "memory center"—the hippocampus—and specific regions of the frontal lobe: specifically, the inferior frontal cortex (Levitin, 2006). In a study conducted to contrast activations occurring while listening to "familiar" with "unfamiliar" popular songs, Pereira et al. (2011) found increased activation when listening to familiar songs in both hemispheres of the brain. In the left hemisphere, activations were recorded in the hippocampus, temporal pole, frontal orbital cortex; the right nucleus accumbens demonstrated increased activity for familiar music. Additionally, the anterior cingulate cortex, amygdala, thalamus, and putamen demonstrated significant activation bilaterally (2011). Listening to or attempting to recall lyrics additionally involves the brain's language centers (e.g. Broca's area, Wernicke's area) and other regions in the temporal and frontal lobes (Levitin, 2006).

Music performance. Performing music involves additional regions of the brain, regardless if one is playing a particular instrument, singing, or conducting. The frontal lobes are again involved in behavioral planning. The motor cortex is involved in movement related to music such as dancing or—in the context of music performance—the coordination of one's movements in playing a musical instrument or conducting. The sensory cortex serves to provide "tactile feedback" that one has moved in the way that one has planned—that one has pressed the right key on an instrument. In addition,

reading music or carefully observing the actions of a performer involves the visual cortex in the occipital lobe (Levitin, 2006).

Emotional response to music. Emotions that are experienced in response to music listening or performance have been linked with the more primitive regions of the brain, such as the cerebellum vermis and the amygdala (Levitin, 2006). Considering the cerebellum's strong interconnections to the frontal lobes, limbic system, paralimbic system, and neocortical association areas, it is, perhaps, unsurprising that some researchers have proposed (and demonstrated) that the cerebellum may serve as a "center" for emotional reactions to music (e.g. Schmahmann, 2001). Along with the cerebellum, the amygdala and nucleus accumbens have been implicated as having a strong role in the emotional impact of music. This makes sense when one considers that these brain structures are known to be components of a network of structures involved in the experience of feelings of pleasure or reward, such as the feeling of listening to music that one finds pleasurable and enjoyable: the amygdala is commonly described as the "heart of emotional processing", and the nucleus accumbens regulates the release of dopamine, which is integral to the "reward system" (Levitin, 2006). Readers can refer to Figure 1 for a visual presentation of the locations of these structures within the brain.

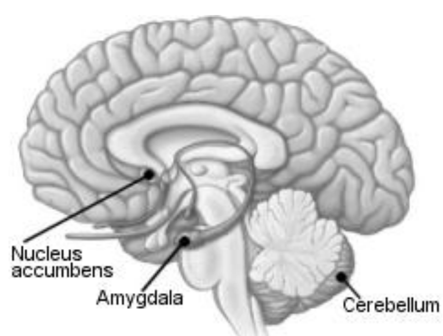

Figure 1. Brain structures associated with emotional response to music.

Evolutionary Origins of Music

Oftentimes, evolution is considered in terms of a purely physiological concept. It is true, of course, that evolution has shaped one's cardiovascular system, gastrointestinal system, and opposable thumbs, but evolution should also be considered in psychological terms. Evolution has not only shaped the anatomy and physiology of the human body and brain, but has also shaped psychological aspects of the human mind—it has shaped such psychological aspects as human dispositions, emotions, intelligence, human language abilities, and cognitive processing systems (Huron, 2001; Morley, 2003; Palmer & Palmer, 2002). However—in the context of a discussion regarding the potential evolutionary origins of musical behaviors—it is not so simple as to pose the question, "What is the *cause* of musical behavior?" It is important in such a context for one to understand that evolution does not decisively determine behavior: traits and behaviors (with at least some genetic component) that are considered to be adaptive to a specific environment are selected as those likely to be passed to future generations. One should instead focus on presented evidence of an evolutionary advantage possessed by those who manifest behaviors of a musical nature (over those who do not; Huron, 2001). Sadly, the evolutionary history of musical ability and behavior has been neglected by the majority of past literature, despite neuropsychological and developmental research (e.g. Carter, 1998; Wallin, 1991) suggesting that musical ability in humans, in fact, possesses a deep evolutionary history; only recently have more-unified approaches to this field of study emerged (Morley, 2003).

Fossil evidence. Archaeologists, biologists, and anthropologists have made astounding discoveries regarding the evolutionary origins of musical behavior over the past several decades. Historically, researchers examining the "prehistory" of music (i.e. music's evolutionary origins) have relied solely on archaeological evidence from the Upper Paleolithic era (circa 40,000-10,000 years ago; Bar-Yosef, 2002); as noted by Morley (2003), however, this narrow focus neglects a large amount of evidence from previous evolutionary stages. Morley instead presented an analysis of archaeological evidence for musical instrument utilization in both the Middle- *and* Upper Paleolithic (circa 200,000-10,000 years ago). The discovery of a variety of potential Middle Paleolithic sound producers has exacerbated an ongoing debate regarding the timeline of musical evolution in hominids among researchers: there is considerable debate regarding exactly when the cognitive fluidity required for hominids to form sound producers (or instruments) emerged. Some researchers (e.g. Mithen, 2006) argued that hominids in the Middle Paleolithic *did*, in fact, possess both the abilities required to sing or make rhythmic vocalizations and the ability to create music with "instruments" (e.g. by banging sticks together or by utilizing flute-like instruments, bullroarers, or rasps). This proposition is supported by sizable amount of data which suggests early hominids possessed any biological structures that would be required to produce musical sounds and sustain them over time.

As presented by Morley (2003), objects originating in the Middle- or Upper Paleolithic which are thought to potentially be musical instruments generally fall into five primary types, the most abundant of which are those thought to be pipes or flutes. Two additional types of possible wind instruments—pierced phalanges or "phalangeal

whistles" and objects often interpreted as "bullroarers" (Dams, 1985; Scothern, 1992)—have also been evidenced. Additionally, there also exists evidence of what some researchers have deemed "rasps", such as the serrated fragment of bone made with tools of stone from the Mousterian of Schulen, Belgium (Bednarik, 2003; Huyge 1990). Finally, some researchers have proposed that caves and features of caves may have also been used as sounding devices (e.g. Dams, 1985). All of the aforementioned examples of sound production devices (or musical instruments) from the Middle- and Upper Paleolithic era are made from bone (with the exception of the caves and features thereof); this is likely the result of "differential preservation"—not an exclusive choice to utilize that particular material (Morley, 2003).

In 1995, a bone fragment (from a bear femur) with the appearance of a flute—the so-called "Neanderthal flute"—was discovered in the breccia of layer 8 (radiocarbon dated to 43,100 ± 700 years B. P.; Nelson, 1997) at Divje babe I cave in Slovenia (Morley, 2003; Turk, 1997). This artifact has garnered a large amount of academic attention, as it is a potentially important discovery regarding the origins of instrumental behavior in Neanderthals—additionally, it may be the oldest reputed musical artifact to date (Morley, 2003). It is important to note that this particular artifact has led to much debate between researchers: while some believe that this artifact is undoubtedly a Mousterian flute, others believe that the features associated with the "flute" are more like to be the product of carnivorous activity. The artifact features two artificial holes in the posterior side of the bone, along with semi-circular features at both the proximal and distal ends of the posterior side which have been proposed to be remains of additional holes; however, in reference to the semi-circular features at the ends of the bone, there is,

according to many researchers, no reason to believe there was purposeful production of these holes—they can be better explained by carnivorous activity. However, many researchers have noted that the damage on the Divje babe I bone is quite abnormal in relation to bones that *have* been subject to carnivorous activity and, in fact, the bone exhibits damage that is difficult to attribute to such activity (Bastiani & Turk, 1997; Morley, 2003; Turk, Dirjec, & Kavur, 1997). The spacing between the complete holes in the bone (35mm) does not match spacing between the canines of known carnivores (the smallest of which was found to be 45mm), so—if the holes were actually made through carnivorous activity—the holes would have likely been made on separate occasions (Morley, 2003; Turk et al., 1997); if these two holes *are* the product of carnivorous action, it is extremely *unusual* activity—the damage (i.e. the two holes) is certainly not easily attributable to any known carnivores at the site without the acceptance of quite unusual activity by the carnivore (Morley, 2003). This example is, of course, but one artifact thought to be a flute-like instrument; however, it was selected to be presented due to its potential importance in calling into question the previously-accepted timeline of musical evolution in hominids.

“Bullroarers”—oval-shaped objects with a hole at one end—are a type of musical instrument which produce a humming noise when whirled on a string. Perhaps the finest example of a bullroarer is the specimen made from reindeer antler recovered from Magdalenian layers at La Roche de Birol (in the Dordogne). The bullroarer, which can be seen in Figure 2, is approximately 18 centimeters long and 4 centimeters wide and is engraved with linear motifs and covered with red ochre (Bahn, 1997; Morley, 2003). While it *is* possible that the claimed bullroarer could have been utilized for some other

purpose aside from the production of sound, it certainly would have been remarkably effective as a sound producer (especially when twirled in a cave), as demonstrated by Dauvois' (1989) production of a replica artifact (as cited in Morley, 2003).

Figure 2. Bullroarer engraved with motifs and covered with red ochre (Bahn, 1997).

Rasps (i.e. "scraped idiophones") are another type of early instrument which can be formed from a piece of bone, wood, or stone; grooves are cut perpendicularly to its length, and these grooves are rubbed against another object, creating a staccato vibration. A Middle Paleolithic mammoth bone from a Mousterian site at Schulen, Belgium has been claimed as one such instrument (Huyge, 1990). This artifact was located along with 18 Mousterian tools and has a number of parallel striations—at least twelve striations remain clearly visible despite the fact that the bone is broken at the striated end. Some researchers suggest the possibility that the visible striations are the product of intense carnivorous gnawing, and the rounded edges are due to salivary action (e.g. Bahn, 1997; d'Errico, Henshilwood, & Nilssen, 2015); however, while this is certainly a possibility, the striations are quite regular in angle, depth, and spacing—in addition, the striations are the *only* evidence of damage to the bone (aside from the break, which shows no other evidence of potential carnivorous activity since being broken). Bahn (1997) noted that—assuming the striations are, in fact, man-made and not traces of carnivorous activity—the Mousterian artifact bears a strong resemblance to other rasps formed from bovine horn from Mexico and the Dutch Antilles.

There are, additionally, potential lithophones in a multitude of caves, most of which are in the Lot region of France (apart from Nerja in Spain, Escoural in Portugal, and a few cases in the Pyrenees mountains). Folded calcite “draperies” (i.e. formations) resound when struck with an object such as a wooden stick, and many researchers believe this fact was noticed by Paleolithic inhabitants (as many of these potential lithophones are battered, and some are even decorated with paint). Interestingly, many of these formations are located in large chambers of caves which could have held quite the large audience (Bahn, 1997).

Despite any aforementioned controversy regarding the emergence of music and purposeful sound production in the timeline of music evolution in hominids, literature has indeed emerged to suggest that, by the time *Homo erectus* emerged in the fossil record, hominids possessed the necessary biological features to produce consonants—and to sing for an extended time period. By this point in evolutionary history, hominids are proposed to have possessed the laryngeal position (e.g. Frayer & Nicolay, 2000), adequate lung capacity (e.g. Jellema, Latimer, & Walker, 1993), and the human-like nose (e.g. Savage-Rumbaugh & Lewin, 1994) necessary to exhibit such behaviors. Research (e.g. Falk, 2000; Finlay & Darlington, 1995) has also suggested that hemispheric discrepancies for language and music began to develop in the brains of hominids around two million years ago, and many researchers propose that, over the following one-and-a-half to two million years, hominids possessed the ability to sing and speak separately.

As a final consideration, Bickerton (2001) noted that a slow emergence of music (as well as language) is largely improbable, as the split of the hominids from other primates is relatively recent. Instead, Bickerton proposed that the acquisition of such

skills as language, music, logic, and mathematics by our species more likely points to a co-evolution of such faculties *together* (rather than gradually and separately)—with each of these faculties influencing the others. Such a proposal serves to urge future researchers to consider the origins of music as a piece of the complex puzzle that comprises the human mind—*not* as a singular function.

Hypotheses of adaptive significance. A variety of hypotheses have been posed in regards to a potential explanation of the adaptive significance of musical behaviors. As described by Huron (2001), these various theories and proposals can be generally divided into a handful of broad categories of theories: sexual selection, social cohesion (i.e. group bonding) and group effort, perceptual development and motor skill development, conflict reduction and safe time passing, and transgenerational communication.

Sexual selection. Sexual selection is a form of natural selection first identified by Darwin in his 1871 work, *The Descent of Man, and Selection in Relation to Sex*. A classic example of sexual selection in action is the peacock's bright tail plumage: the peacock tail does not serve to promote the survival of the peacock—in fact, it can easily be seen as a "handicap" for the individual peacock's survival. However, the tail does serve a purpose: its function is to promote the survival of the peacock's *genes* (Huron, 2001). Darwin (1871) was, in fact, the first to propose that musical behavior is a product of sexual selection pressures. Music is comparable in function to sexually-selected acoustic displays in other species (e.g. mating calls) and is noticeably used in courtship rituals (Miller, 2000). Miller further suggested that musical abilities (e.g. dancing, singing) may be "indicator traits" for such sought-after qualities as aerobic fitness, strength, and overall health: the ability to learn complex music may, in essence, serve as a predictor of

cognitive ability as a whole. Additionally, the development of musical ability could serve as a "handicap" on the bearer, as a large amount of time, energy, and dedication is generally required to learn and perfect complex musical arrangements (Miller, 2000). Furthermore, some researchers hypothesize that singing could have been a precursor to the development of language (Huron, 2001), another "indicator trait" which allows an individual to assess cognitive abilities (e.g. intelligence) in another (Palmer & Palmer, 2002). However, many researchers disagree with the theory of sexual selection in relation to the development of musical ability—not only is the fact that the fossil record does not necessarily support this claim often cited, but it is also important to note that there is no dimorphism in the context of musical ability that is commonly associated with sexual selection (Huron, 2001; Mithen, 2006).

Social cohesion and group effort. The social effects and functions of music are undeniably important. Some researchers (e.g. Benzon, 2001; Dissanayake, 1988, 1999; Freeman, 2000; Huron, 2001) proposed that music creates—or at the least maintains—social cohesion and is important in group bonding. Musical behavior may contribute to group solidarity and promote altruistic behaviors—thus increasing the effectiveness and efficiency of collective actions (Huron, 2001). Oftentimes, music is functional, as it is can promote well-being through the facilitation of human contact, meaning, and human imagination of possibilities (Schulkin & Raglan, 2014). Music does, undoubtedly, create a feeling of "oneness" or unity within a group for some individuals; for example, many individuals have likely experienced this feeling of unity during group singing (such as in a church choir; e.g. Kreutz, 2014; Pearce, Launay, & Dunbar, 2015). Additionally, music may contribute to the efficient coordination of work conducted by groups (e.g. moving a

heavy object; Huron, 2001). Why is this? While there has been no extensive research conducted in attempt to answer this question, Freeman (2000) proposed a relationship between oxytocin and social bonding—specifically, group music making. Oxytocin is a hormone that is known to be released upon reaching orgasm during copulation, as well as in females who are lactating (Pedersen, Caldwell, Jirikowski, & Insel, 1992). Freeman (2000) suggested that oxytocin is released into the basal forebrain during sessions of group music making. The release of oxytocin is believed to facilitate a "loosening" of synaptic connections, leaving an individual's neural connections to be open to new information regarding a social group. Again, at the time of this writing, there has been little research regarding the release of oxytocin during group music making—most research in related to the "Freeman hypothesis" has been focused on the examination of monogamous animals and bonding behavior (Damasio, 2003).

It has also been suggested by some researchers (e.g. Dissanayake, 2000) that, at a specific point along the human evolutionary timeline, infant directed speech (IDS) in mother-infant interactions grew more intense and frequent. Perhaps this increased IDS was even musical in nature—Cordes (2003) demonstrated that melodic contours for IDS closely correlate with melodic contours of traditional societal songs. As infants grew to rely on closer interaction with their mothers, IDS is thought to have increased in intensity out of necessity; this more intimate interaction between mother and child is proposed to have led to high-intensity (and perhaps musically inclined) IDS. Consider the soothing cooing and singing behaviors of today's mothers; after ancestral hominids began walking upright, mothers are hypothesized as exhibiting such behavior towards their infants. This increased IDS and mother-infant interaction may also hearken back to Freeman's (2000)

hypothesis regarding oxytocin—this form of interaction may stimulate the release of oxytocin in both mother and infant; oxytocin has been demonstrated as being released in breast milk, another mother-infant interaction that is generally thought to serve as a bonding interaction (Pedersen et al., 1992). This potential explanation of the evolution of musical behavior does, indeed, seem logical; if musical behavior is utilized in mother-infant bonding interactions, the adaptive qualities of such behavior likely seem somewhat obvious. Perhaps, then, it is this potential adaptive significance of musical behavior that serves as the source for humans' predisposition for learning and enjoying music.

For a proposal regarding the evolution of musical behavior that is based on mother-infant interaction to be accurate, infants must possess the ability to distinguish differing pitches and rhythms in a similar manner to adults; if an infant is unable to do so, it is likely the infant would also be unable to distinguish intended meanings or emotions in the IDS. Much research (e.g. Trehub, 2001; Trehub, Schellenberg, & Hill, 1997; Trehub, Schellenberg, & Kamenetsky, 1999; Trehub & Trainor, 1993) has demonstrated that, in fact, the perception of music in infancy and adulthood is remarkably similar: infants have been shown to be developed well beyond the minimal criteria required for the perception of music. Additionally, infants are quite perceptive of emotional content in music: infants as young as six months have been demonstrated as possessing the ability to distinguish between "happy" and "sad" music (Flom et al., 2008) and have also been shown as demonstrating a preference for consonant as opposed to dissonant music (Hill & Palmer, 2010; Zentner & Kagan, 1998). By the age of three years, children possess the ability to accurately distinguish between such emotions as sadness, anger, and fear (Cunningham & Sterling, 1988); by the age of six years, children have begun to use

adult-like procedures of determining potential emotional meaning in music through the combination of tempo and melodic structure (Peretz, 2001). Such findings certainly provide strong evidence supporting the mother-infant interaction theory of the evolution of musical behavior.

Perceptual and motor skill development. Some researchers have proposed that musical behavior—specifically, listening to music and singing (or other music-making behaviors)—may have served to aid in the advancement of perceptual and/or motor skill development. In the context of perceptual development, some researchers have hypothesized that music might have, in some way, aided individuals in becoming more perceptive in general—for example, listening to music may have served to provide an exercise in hearing. Singing—along with other music-making activities (e.g. utilizing the artifacts described previously—may have provided the opportunity to advance and refine the motor skills of *Homo sapiens'* ancestors. Furthermore, some researchers hypothesize that singing could have been a precursor to the development of speech (Huron, 2001). Indeed, in a superficial manner, music and language processing and production do seem similar—many would likely assume that there would be at least some overlap between the two types of processing (e.g. semantic and harmonic); however, there is still a considerable amount of research to be conducted on brain structures involved in music and language (and their similarities and differences), and there appears to be at least a basic difference in processing between the two.

Other proposals. Huron (2001) presented three other broad hypotheses proposed by a variety of researchers regarding the evolutionary origins of musical behavior, the first of which relates to conflict reduction. In comparison with speech—which may often

escalate conflict or lead to arguments (or even physical fights)—music is thought by many to *reduce* interpersonal conflict. For example, singing around a campfire may be a safer social activity than talking or sharing one's thoughts. Along the same general area of thought, some researchers have suggested that musical behavior may have also served as a safer time passing activity: as hominids became more effective hunters and gatherers—thus leaving more "free time" than when hunting and gathering were more lengthy, exhaustive activities—music could have arisen as a safe pastime. Finally, some researchers have proposed that the evolutionary importance of musical behavior may lie in transgenerational communication. These researchers suggested that music could provide a comparatively effective method of communicating useful information over long periods of time.

All of the hypotheses regarding the evolutionary origins of musical behavior discussed in this writing likely seem logical to most readers; in addition, many of these hypotheses have substantial evidence in support of the proposals therein. It is clear that the answers to questions involving music's origins are not simplistic in nature, and most of the potential answers which have been provided are, for the most part, speculative in nature. This researcher's opinion is in alignment with the opinion presented by Hill (2009) that, perhaps, music has held a variety of roles at differing points along the evolutionary timeline of humans. In the more primitive stages of human evolution—in a time when "indicator traits" were most relevant, the sexual selection theory of music origins proposed by Darwin (1871) and advanced by Miller (2000) may have been true. As humans further evolved over time, musical behavior could have served other purposes, filling other roles in the lives of early hominids—presenting a safer time

passing activity, reducing interpersonal conflict, and aiding in the development of stronger social interaction and bonding both between mothers and their infants and between adult individuals. Even today, it is undeniable that listening to and creating music through the playing of instruments or singing creates a feeling of unity—a feeling of social cohesion. Questions regarding music's origin may never be fully answered; nevertheless, it is worthwhile to consider, as an understanding of the potential origins of musical behavior may surely be helpful in understanding human response and attraction to music.

Music, Emotion, and Mood

Emotion and mood are two terms that are commonly used interchangeably in psychological practice, but it is, nevertheless, important to distinguish the two. Fish, Casey, and Kelly (2007) defined emotion as "a stirred-up state caused by physiological changes occurring as a response to some event and which tends to maintain or abolish the causative event"; by contrast, mood is defined as "a pervasive and sustained emotion that colours the person's perception of the world" (p. 65). Most researchers view mood as a generally more prolonged feeling, but emotion, on the other hand, can be quite short lived (e.g. Fish et al., 2007; Mithen, 2006). While it is important to define and distinguish the two terms, emotion and mood are, in fact, closely interrelated: mood can be described as a disposition to react to events with a specific kind of emotion, while emotion can be described as a subjectively experienced feeling that is related to one's affect or mood (Kohn & Keller, 2015; Pathak, Bhatia, Sriniwas, & Batra, 2011).

Emotion and mood play undeniably important roles in the everyday lives of individuals—emotion's influence is so strong that it possesses the potential to influence

an individual's decision making in contexts from helping behavior (Isen, 1970) to consumer decisions (Loken, 2006). Music has even been described as the "language of emotions" (e.g. Cooke, 1959; Juslin, 2013b); many would likely agree that it has the ability to affect emotions in a manner that neither books, art, nor films can equal (Stubing, 2012). Music is oftentimes interpreted by listeners as expressive of emotions: in fact, expression of emotion has generally been considered to be one of the most vital criteria for the aesthetic value of music (Juslin, 2013a, 2013b). There exists evidence to provide support for this view: in a questionnaire study, Juslin and Laukka (2004) asked participants to identify what they believed was expressed through music from a list of options based on the literature regarding expression in music. Unlike any other option presented, "emotion" was selected by every single participant.

As mentioned in an earlier section, emotion in response to music has been linked to the cerebellum and amygdala—the more primitive areas of the brain. Some researchers believe the cerebellum to be the region of the brain in which some of the emotional properties of music are created (i.e. the cerebellum may serve as a "center" for emotion in response to music; Levitin, 2006; Schmahmann, 2001); this fact is, however, debatable. The amygdala, on the other hand, has long been considered to be the "heart of emotion" and is the structure most commonly associated with emotional response (Levitin, 2006). A study conducted by Blood, Zatorre, and Bermudez (1999) demonstrated that regions of the brain generally thought to be involved in reward and arousal (e.g. the amygdala, ventral striatum, midbrain, and portions of the frontal cortex) are associated with intense musically-induced emotion. The amygdala, ventral striatum, and midbrain are located near the nucleus accumbens—oftentimes referred to as a "pleasure and reward system" in

the brain (Salgado & Kaplitt, 2015)—which consists of a large number of dopamine receptors. Interestingly, the nucleus accumbens has also been shown as playing a strong role in the emotional response to music (Levitin, 2006), suggesting that the "pleasure and reward center" in the brain may be integral to musically induced emotion. In fact, many neuropsychological theories propose that positive emotions and moods may involve an increase in dopamine levels (Fredrickson, 2001).

Commonly expressed emotions. There are many finer details to consider regarding emotional response to music, one of which may be the various "types" of emotions that music has the potential to express. Most readers would likely agree there is, in general, a wide variety of emotions that can be portrayed through music, and any particular musical piece can evoke differing emotions on an individual basis. In a sense, it would be inappropriate to consider these statements to be false. Some researchers suggest that one should first be mindful of the fact that a music listener can personally perceive *any* emotion or combination of emotions in a musical composition (Juslin 2013b; MacDonald, Gunter, & Mitchell, 2012). Furthermore, Juslin noted that "the subjective impression of an individual listener cannot be disputed on objective grounds"—therefore, it is vital to accept the "unique impressions" of individual listeners (2013b, p. 2).

By contrast, some researchers suggest a view of emotional expression in music that is more strict: emotional expression in music should be indexed based on some minimum level of listener agreement among individuals. It is assumed that—when agreement among multiple listeners exists—there must be *something* in the music that is conveying this similar emotional impression in listeners (Campbell, 1942; Juslin, 2013b). One should note that—no matter how exactly one indexes the various emotions that can

be expressed through music—the expression of emotions does not necessitate that there is correspondence between the emotion perceived by the listener and the emotion intended to be conveyed by the composer or performer. This level of correspondence between composer or performer and listener would instead be referred to how reliably the intended emotion was *communicated* and could be utilized to catalog emotional expression in terms of accuracy (Juslin, 2013b).

Juslin (2013b) compiled data from three self-report studies in which participants (i.e. listeners) were asked what emotions they believed music could express. In each of these studies, participants could select from a lengthy list of emotions. Happiness (or joy), sadness, anger, fear (or anxiety), and love were among the top ten emotions selected by participants in the three studies regardless of sample characteristics; furthermore, happiness (joy) and sadness were the top two emotions selected in each study (Juslin & Laukka, 2004; Kreutz, 2000; Lindström, Juslin, Bresin, & Williamson, 2003). Importantly to this writing, calm was also included in two of the three studies (Juslin & Laukka, 2004; Lindström et al., 2003); calm was not included in the Kreutz (2000) study as an option presented to participants, however. Thus, some form of agreement seems to exist regarding the emotions which are most easily (or most commonly, perhaps) expressed through music. It should be noted that, while the emotions denoted in the aforementioned studies *do*, for the most part, correspond to theories of "basic emotions" proposed by some researchers in the music psychology field, Juslin (2013b) highlights the fact that other (i.e. "non-basic") emotions have also been reported as arousing in response to music, such as nostalgia, interest, arousal, and pride or confidence.

In attempt to explain the fact that some emotions seem to be easier to express in musical form than others, it is necessary to examine the underpinnings of the musical perception process: specifically, how emotion is “coded” in music (i.e. *how* the music portrays the emotion; Juslin, 2013b). Dowling and Harwood (1986) proposed three categories of emotional coding in music: icon (henceforth referred to as iconic), symbol (intrinsic), and index (associative). Iconic coding of emotional expression in music is hypothesized to be based upon innate, involuntary, and emotion-specific physiological changes that are associated with specific emotional responses; these physiological changes are thought to influence components of voice production (Juslin 1997; 2001). This type of coding is hypothesized to be intimately related to everyday emotions (Juslin, 2013b). More complex emotions, on the other hand, are coded through intrinsic or associative coding. Intrinsic coding of emotional expression have not been thoroughly investigated thus far: however, Juslin (2013b) provided some speculation regarding the characteristics of this process. It is thought to be unlikely to express specific emotions; instead, it aims to “qualify specific emotions conveyed by iconic or associative coding” (p. 9). Through intrinsic coding’s contribution of shifting levels of such constructs as tension, stability, and arousal, it may aid in the expression of such emotions as relief and hope. Finally, emotional expression may also be perceived simply based on something in the music (e.g. a specific timbre or a familiar melody) being arbitrarily paired with other stimuli or events that are meaningful to the individual repeatedly in the past. For example, organ music may be perceived as expressing “solemnity” (because it is commonly heard inside of churches; Juslin, 2013b); or, more specifically, the anthem of an individual’s country may be perceived as expressing “patriotism” (Dowling &

Harwood, 1986). In terms of *overall* expression, the three types of coding can be considered as "layers" or "levels" of emotional expression in music. The core level—iconically-coded emotions—can be qualified, extended, and even modified through the addition of two more layers (i.e. intrinsic and associative coding), thus enabling perception of more complex emotions by the individual (Juslin, 2013b).

Researching music and emotion. Some researchers propose that the emotional responses to music often experienced by individuals are cultural—this would suggest that these emotional responses are learned throughout an individual's lifetime. The musical scales that are utilized in Western cultures (and have been for centuries) are thought by some to contribute to the onset of emotional responses to music. The major scales have generally been associated with positive emotional valence (e.g. happiness, contentment, tenderness, etc.), while, on the other hand, minor scales have been associated with negative emotional valence, such as sadness, anger, fear, or sorrow (Cooke, 1959; Parncutt, 2012). However, not all researchers ascribe to this view—many are not so quick to ignore the possibility of a cross-cultural variable that may cause emotional responses that are similar: many more recent studies conducted have demonstrated a potential cross-cultural variable which may affect emotional response to music (Oelman & Lœng, 2003).

In the past, researchers who were interested in the study of emotion were forced to rely on self-report data, which remains the norm for research on emotion, mood, and affect (and which has, therefore, been applied to research regarding music and emotion; Hill & Palmer, 2010). Recently, however, those interested in the study of emotion have had the ability to utilize more modern advances in modern science, such as fMRI, which has been incorporated as an additional tool for studying such things as the regions of the

brain activated in response to language and music. Today, there are a multitude of studies in the psychological literature that have relied upon the use of fMRI and other neural imaging tools; for example, there are a variety of studies which have demonstrated the increase in activity in dopaminergic regions of the brain (e.g. the ventral striatum and nucleus accumbens) while listening to familiar and pleasurable musical pieces (see Blood, Zatorre, & Bermudez, 1999; Schmahmann, 2001). Physiological measures—such as heart rate or respiratory measures—have also been utilized in testing potential emotional responses to music: some studies have demonstrated physiological responses to music that were thought to be typical of the specified emotion—such as accelerated heart rate when listening to fear-inducing musical compositions and decelerated heart rate when listening to sad or solemn pieces (see Etzel, Johnsen, Dickerson, Tranel, & Adolphs, 2006; Krumhansl, 1997).

Scientists have also conducted research in attempt to pinpoint the aspects of music which affect humans emotionally. One such aspect that has been hypothesized as contributing to this emotional response is tempo—specifically, the decreasing and increasing of tempo. However, research has confirmed that decreasing or increasing tempo alone (without any other variation in other elements of the music) does not affect participants' moods (Husain, Thompson, & Schellenberg, 2002). An interaction between tempo and some other element(s) of music is more likely. Khalfa, Roy, Rainville, Dalla Bella, and Peretz (2008) demonstrated that psychophysiological distinctions between "happy" and "sad" music do not rely on tempo alone, but instead require tonal variations paired with differences in tempo and rhythm: this is, perhaps, evidence of a potential interaction between tempo and melody that contributes to emotional responses to music

experienced by humans. Recall that the musical scales (e.g. major scales and minor scales) utilized in Western cultures are thought by some to contribute to emotional responses to music. The major scales have generally been associated with positive emotions, while minor scales have been associated with negative (Cooke, 1959; Parncutt, 2012). Trehub, Cohen, and Guerriero challenged this proposal in a 1987 study (as cited in Trehub, 1993) in which they presented both children and adults with ascending and descending major or minor scales from different musical keys. The main effect of direction was, in fact, significant; however, only musically-trained adults associated the major scales with happiness and the minor scales with sadness consistently. This suggests that musical key does not alone influence the emotional valence of the melody line of a particular musical composition.

Musically-induced mood. With the surging interest in emotion research (as well as research regarding the emotional response to music), some researchers have become interested in testing the potential mood-inducing ability of music: musical mood induction has become somewhat popular throughout a variety of research areas in the field of psychology. One such avenue of research is that of alcohol preference. Birch et al. (2008) utilized negative musical mood induction to demonstrate which types of moods activated implicit alcohol cognition in undergraduate students; Birch et al. (2004) demonstrated that the induction of happy and sad mood through music have the ability to affect cognitive cravings of individuals who drink alcoholic beverages.

Goldstein and Willner (2002) used musically-induced moods to elicit negative moods (e.g. sadness) in individual participants. Importantly, the moods of participants in this study were not only “slightly modified—they were significantly changed, as

evidenced by significantly increased scores on the Beck Depression Inventory (BDI); by contrast, participants in the musically-induced positive mood group reported lowered scores on the BDI. Individuals in the negative mood group additionally demonstrated increased feelings of both entrapment and defeat according to their Entrapment and Defeat Scales scoring. Mongrain and Trambakoulos (2007) utilized musically-induced negative and positive moods in attempt to lower dysfunctional attitudes in historically dysfunctional patients who were either overly self-criticizing or needy. Indeed, in this study, musically-induced moods led to patients reporting lower frequencies of dysfunctional attitudes.

Musically-induced mood has also been utilized in research in attempt to facilitate cognitive ability in study participants. Some researchers (see de l'Etoile, 2002; Thaut & de l'Etoile, 1993) utilized musically-induced mood to test the potential effects of mood-congruent memory. Clark, Iversen, and Goodwin (2001) utilized music to induce moods in participants with the assumption that the alteration of mood would affect performance on tasks that are generally associated with the frontal lobes of the human brain. Findings did not, in fact, support the researchers' hypothesis that musically-induced mood could affect frontal lobe functioning. However, the researchers *did* demonstrate that participants reported that they felt the intended mood to be induced.

A comprehensive review of the musical mood induction procedures utilized by various researchers has been compiled by Västfjäll (2001). Additionally, this review indexed a considerably large volume of research which utilizes music as a tool for mood induction. Much research has originated from these procedures, demonstrating that mood can be consistently altered through the utilization of musical excerpts.

Criticisms of research on musically-induced mood. Research regarding musically-induced mood has been the subject of criticisms; according to Hill and Palmer (2010), the claim that music can alter an individual's mood state has been undermined by three criticisms related to music-based research: (a) music merely *expresses* mood—it does not induce it (i.e. the "cognitivist" view of emotion and music), (b) a lack of evidence regarding the mechanisms by which music induces moods, and (c) the use of self-report measures (i.e. subjective methods) to measure the suspected induced moods. The first criticism—that music can express mood or emotion, but not induce it—arises from the cognitivist view that participants exhibit a tendency to mistake the recognized emotional expression of music for their own mood or emotions. Generally, this issue is addressed through the specification that participants should only report how *they* feel—*not* the emotion they believe is expressed in the music. In fact, Scherer and Zentner (2001) demonstrated an observed difference in self-reported mood when participants were asked to report *only* how they actually felt.

The second potential problem with musically-induced mood research discussed in Hill and Palmer (2010) suggested that up to six cognitive processes (e.g. visual imagery, episodic memory, and expectation) may occur in the process of music listening—any combination of which may induce feelings of emotion or mood in the listener. Juslin and Västfjäll (2008) suggested that, while this may be true, these cognitive processes are by no means exclusive to music listening, and, therefore, emotional response to musical pieces may simply be related to emotional response to other stimuli to the extent that they employ the same cognitive processes.

The third problem facing research on the relation between music and emotion discussed (and addressed) by Hill and Palmer (2010) is related to the gathering of affect, mood, and emotion data through subjective self-report methods. The self-report method is certainly typical of research on concepts such as emotion and mood, and it has, thus, come to be commonly applied to research related to musically-induced mood and emotion. Of course, the problems associated with self-report measures (e.g. issues surrounding potential demand characteristics) must be considered in *any* research utilizing this method of data collection. However, Kenealy (1988) experimentally manipulated demand characteristics and found no significant effect on participants' self-reported moods in music-based research.

Finally, while a multitude of researchers have conducted studies related to music and musically-induced mood, many of these studies are not generalizable or comparable to other studies. In general, this difficulty in comparing such studies is due to varying methods and stimuli—both of which have potentially severe implications on both theory development and verification. The Vieillard et al. (2008) musical clips were developed in attempt to address this lack of consistency in methodology (Hill & Palmer, 2010).

Normed Musical Stimuli

In response to the extreme inconsistency in methodology in music research, Vieillard et al. (2008) worked to provide a set of normed stimuli for use in this type of research (Hill & Palmer, 2010). Dr. Isabelle Peretz and her colleagues (i.e. Vieillard et al., 2008) developed fifty-six (56) musical clips for utilization in music-based emotion research. The 56 clips were divided into four groups of 14 clips; each group was intended to evoke a differing emotion (i.e. happy, sad, peaceful, scary). These emotions were

chosen as they can be seen as both categorical (e.g. Ekman, 1982) and dimensional (e.g. Russell, 1980): this means that the emotions associated with the clips can be treated as bipolar elements on opposite ends of an affective dimension; thus, while “peaceful” is not generally considered one of the two “basic emotions” (refer to the discussion provided in a previous section), Vieillard et al. (2008) included it to provide a dimensional opposite to the “scary” clips. The “happy” and “sad” clips were also created as dimensional opposites—however, happy and sad conform better to the idea of “basic emotions” (Hill & Palmer, 2010). The excerpts were digitally constructed in piano timbre through the utilization of computer software and were composed with the musical trends of Western cultures in mind: the “happy” clips were composed using a major scale with a fast tempo; by contrast, the “sad” clips were composed using a minor scale with a slow tempo. “Scary” clips were also composed using a minor scale, but with an intermediate tempo; additionally, most of the “scary” clips were composed with regular rhythm and consonance, but some were irregular and dissonant (such as in the older horror film soundtracks). “Peaceful” clips were composed in a major mode with a slow-to-intermediate tempo (Hill & Palmer, 2010; Vieillard et al., 2008). Of course, these descriptions are somewhat generalized—readers who are musically inclined can refer to the Vieillard et al. (2008) appendixes for musical scores.

Juslin (1997) demonstrated that professional musicians were extremely effective in playing the same song but conveying different moods (e.g. happiness, sadness, and fearfulness); most participants in the study were able to correctly identify the emotion intended to be conveyed through the music. A variety of musical techniques were applied to convey the intended emotion: for happiness, a staccato articulation (in other words, the

notes are short and spread apart) and a fast tempo; by comparison, sadness was expressed with a legato articulation (i.e. notes are played in close succession) with a slow tempo. Fearfulness was portrayed through the music by utilizing a low volume, staccato articulation, and slow tempo. The Vieillard et al. (2008) musical excerpts were developed closely following the musical techniques utilized by the musicians in the Juslin (2007) study. The excerpts were additionally tested for valence, arousal, and efficiency of emotion expression.

Vieillard et al. (2008) conducted a study to test the ability of participants to correctly recognize and identify the intended emotion within the developed musical clips. Two sets of instructions were utilized: one set (provided to one group) urged participants to *only* attempt to recognize the intended emotion within the musical clips, while the second set (provided to another group) urged participants to focus on their own *personal* emotional experience while listening. Interestingly, participants more commonly correctly recognized and identified the intended emotion within the musical clips when instructed to focus upon their own experience. Vieillard et al. proposed that this can be seen as support for the idea that emotional recognition and experience differ *only* in strength; Hill and Palmer (2010) attempted to evaluate this claim while simultaneously striving to minimize general concerns regarding music and emotion research (discussed in a previous section; e.g. the researchers instructed participants to distinguish between "how the music sounds" and "how they felt"). Hill and Palmer utilized only the "happy" and "sad" clips (a total of 28 clips), as they were judged by the researchers to be most useful for evaluation of the Vieillard et al. claim. The researchers hypothesized that individuals who listened to the "happy" clips would score higher on the Elated-Depressed

subscale of the Semantic Differential Feeling and Mood Scale (SDFMS) than would participants who listened to the “sad” clips. Indeed, the results of the Hill and Palmer (2010) study documented a statistically significant difference in self-report state affect between participants who listened to “happy” and “sad” clips.

Further, Hill (2009) introduced the scary and peaceful musical clips (as well as the happy and sad clips and a white noise control group) in attempt to demonstrate the musical clips’ mood-inducing ability. In Hill’s study, the SDFMS developed by Lorr and Wunderlich (1988) was utilized to assess the participants’ moods. Indeed, the clips developed by Vieillard et al. (2008) demonstrated (yet again) a significant effect on participants’ moods. Hill’s study demonstrated a significant difference in self-reported elation (via the SDFMS) between participants exposed to the happy musical excerpts as compared to those exposed to the sad excerpts. The peaceful clips were demonstrated as eliciting higher levels of relaxation (self-reported on the SDFMS) as compared to the scary music—however, these results were statistically nonsignificant, though Hill suggests further research may be needed before assuming no substantial effect would occur between the two groups of musical clips. Both the Hill (2009) and Hill and Palmer (2008) studies provide strong support for the utilization of the Vieillard et al. (2008) normed (i.e. standardized) musical clips in musically-induced mood research in attempt to better organize research on musically-induced mood; however, further research is, indeed, needed, as suggested by Hill (2009).

The Eysenck Personality Questionnaire (EPQ)

Over the course of many years, Eysenck (1952; Eysenck & Eysenck, 1976; Eysenck, Eysenck, & Barrett, 1985) developed a three-factor model of personality (along

with a “Lie” scale to distinguish individuals who may be purposefully attempting to deceive); the model was, in part, developed with reference to earlier models developed by Wundt (1903) and Kant (1912). Eysenck’s Personality Questionnaire laid the foundation for at least a half-century of research on personality and is still utilized in a wide variety of studies today. To develop the EPQ, Eysenck collected immense data sets on a variety of measures and subjected them to a factor analysis, and this procedure was replicated a number of times throughout his career; the same fundamental personality traits were consistently identified throughout these analyses.

Eysenck’s personality model originally included only two “superfactors” of neuroticism and extraversion—factors previously discussed by Wundt and Kant (though in different terms). These two factors are orthogonal, allowing an individual to score relatively high or low on either factor. The third factor, psychoticism, was added at a later date in response to behaviors exhibited (and witnessed by Eysenck) in hospitalized soldiers. This model—the Psychoticism, Extraversion, Neuroticism (PEN) model, EPQ-R (revised; Eysenck & Eysenck, 1975)—was developed primarily for use in psychopathology research; however, since its creation, researchers have used the EPQ-R in a variety of contexts with a multitude of different hypotheses in mind concerning specific factors of the EPQ (e.g. Ge, Se, & Zhang, 2015; Pedersen & Reynolds, 1998). Eysenck et al. (1985) devised a short scale format of the EPQ-R (henceforth referred to as the EPQ-R-S) for use among adults, as well, as there are commonly practical disadvantages in the utilization of longer tests when time is limited. This format of the EPQ includes four indices (i.e. psychoticism, extraversion, neuroticism, and the lie scale), each of which contain 12 questionnaire items (Francis, Brown, & Philipchalk, 1992).

Francis et al. (1992) also developed an "abbreviated" form of the short scale EPQ-R (the EPQ-R-A) which contained only six items on each scale, as the researchers felt that, in some instances, a 48-item questionnaire may still be too long for convenience. However, as one might predict, this abbreviated form recorded lower reliability coefficients than the longer scales from which they were derived, and alpha coefficients and correlation between the EPQR-A psychoticism scale and the EPQ-R and EPQ psychoticism scale were low (though still considered "acceptable" by the researchers; Francis et al., 1992). Therefore, in this study, the EPQ-R 48-item questionnaire was selected for use.

EPQ personality factors. Psychoticism—the most recent addition to Eysenck's three-factor personality model (Eysenck & Eysenck, 1976)—can be described as viewed by Eysenck as including such personality traits as impulsivity, aggressiveness, egocentricity, and creativity (Eysenck & Eysenck, 1975). Importantly, the addition of the psychoticism scale as a dimension of the EPQ was accompanied by a multitude of criticisms regarding the psychometric properties of the scale. Eysenck et al. (1985) acknowledged this psychometric weakness, and worked to improve the psychometric soundness of the psychoticism scale through the design and testing of new items to be added to the scale (as well as through the removal of some items due to inconsistent loadings on the psychoticism factor). Despite this, psychoticism has still received relatively little attention in psychological literature as compared to the other factors of extraversion and neuroticism; some interesting studies involving the psychoticism factor of the EPQ do, in fact, exist, however, in the research areas of impulsivity and reward sensitivity (e.g. Russo, Leone, Lauriola, & Lucidi, 2008), recognition of socially relevant

emotional stimuli and related neural correlates (e.g. Surquladze et al., 2008), and occupational stress in educators (e.g. Kumari, 2008).

Extraversion is likely the most well-known factor of the EPQ, and it is certainly the most readily recognizable by the nonscientific population—many individuals easily identify as being either introverted or extraverted. Individuals reporting high levels of extraversion tend to exhibit such traits as liveliness, sensation-seeking, dominance, and assertiveness and are generally sociable and carefree (Eysenck & Eysenck, 1975). Because extraversion is likely the most popular of the three personality traits incorporated in the EPQ, there is, of course, a vast amount of past and contemporary research that has focused on extraversion and its relation to other psychological phenomena (e.g. Amichai-Hamburger, Kaplan, & Dorpatcheon, 2008; Igarashi, Motoyoshi, Takai, & Yoshida, 2008 van Schoor, Bot, & Engels, 2008).

Like extraversion, neuroticism was one of the original two "superfactors" identified by Eysenck and utilized in the development of the EPQ. Individuals reporting high levels of neuroticism on the EPQ tend to exhibit such traits as tenseness, irrationality, and anxiousness and are commonly moody and emotional (Eysenck & Eysenck, 1975). Neuroticism has also been the subject of a large body of research regarding a variety of psychological topics such as the effects of neuroticism and mood on the retrieval of personal negative memories (e.g. Ruiz-Caballero & Bermúdez, 1995), trait and state measures of arousal (e.g. Wilding & Mohindra, 1982), and the effects of neuroticism on test anxiety and an individual's mood (e.g. Gilbert, Stunkard, Jensen, Detwiler, & Martinko, 1996).

Neuroticism and its emotional implications. Eysenck (1967) generally hypothesized that individuals would differ on personality measures based on physiological responses, as he believed that personality is rooted in biology and may be genetic, at least to some extent. In his 1967 work, Eysenck attempted to explain the potential biological basis of personality using two previously-identified systems of arousal. The first of these arousal systems discussed and linked to personality traits by Eysenck was the ascending reticular activating system (ARAS). The ARAS is known to be responsible for excitation and inhibition patterns of the cerebral cortex and was, thus, linked to the extraversion trait of personality by Eysenck. Theoretically, individuals who reported high levels of extraversion would be expected to be generally less aroused than individuals who do not report high levels of extraversion and, thus, are likely to more commonly seek arousal from their surrounding environments. The second arousal system discussed was dubbed by Eysenck as the "visceral brain" (VB); the VB is now known as the limbic system. The limbic system is primarily responsible for the regulation of emotional expression and such autonomic physiological regulatory responses as heartrate, blood pressure, and perspiration, among other functions (Eysenck, 1967). This system is, interestingly, known to be associated with the processing of emotional responses of all stimuli—including music (see Jäncke, 2008).

Hill (2009) hypothesized that individuals scoring high on Eysenck's Personality Questionnaire (revised; EPQ-R) would be more severely affected emotionally by the various musical excerpts utilized in this study. While results regarding this hypothesis were varied (suggested by Hill to likely be due to the SDFMS' not being sensitive enough to effectively detect the changes in mood), individuals in the high neuroticism

group *did* report lower levels of elation than those in the low neuroticism group; additionally, individuals in the high-neuroticism group rated themselves more highly on the SDFMS subgroups of timidity and fatigue. Additionally, while no significant difference between high- and low-neuroticism groups were found while listening to "happy" music, there *was* a significant difference between high- and low-neuroticism groups when listening to "sad" and "scary" music. Hill (2009) highlighted the importance of personality characteristics in the process of inducing mood through music.

In a study conducted by Rafienia, Azadfallah, Fathi-Ashtiani, & Rasoulzadeh-Tabatabaiei (2008), 120 participants who had previously exhibited extreme scores in neuroticism and extraversion were subjected to either negative or positive mood induction procedures, including the use of vignettes and musical mood induction through the use of either "pleasant" or "unpleasant" Iranian musical excerpts. Post-mood induction, the moods of participants were measured through the utilization of the Positive and Negative Affective Schedule (PANAS). Following the mood induction procedures and PANAS completion, participants were asked to complete a variety of tasks, including free recall, story completion, and probability rating. In the free recall task, participants were presented with an itemization of twelve words; words included in the list were either positively, negatively, or neutrally emotionally charged. Participants were then asked to recall these words after some time had elapsed. In the story completion task, participants were simply given a topic sentence and were asked to complete the story; stories were read and rated for positive or negative emotional content. In the probability rating task, participants were presented with sixteen probability judgements—eight

positive and eight negative—and were asked to rate their scores on a scale of one to seven (Rafienia et al., 2008).

Results of the study conducted by Rafienia et al. (2008) indicate that Eysenck's personality traits (e.g. neuroticism, extraversion, and psychoticism) may influence an individual's processing of emotional stimuli. Rafienia et al. (2008) found that individuals who had reported high levels of neuroticism displayed a tendency to demonstrate more negative interpretations and judgments; by contrast, individuals who had reported high levels of extraversion demonstrated more positive interpretations and judgments. This finding is also congruent with a rather immense research base suggesting individuals reporting high levels of neuroticism have a tendency to process stimulus information in a more emotionally negative manner (for examples, see Bradley & Mogg, 1994; Darvill & Johnson, 1991; Martin, Ward, & Clark, 1983; Peterson, Safer, & Jobes, 2008; Rusting & Larsen, 1997).

The findings of these studies (along with many others) indicate that individuals who report high levels of neuroticism are more likely to be affected by emotional stimuli than individuals who report low levels of neuroticism. Hill (2009) noted an interesting common thread in many of these studies: the use of musical or melodious stimuli to test mood differences between individuals reporting high and low levels of neuroticism.

Psychoticism and its emotional implications. In contrast to individuals scoring high on the neuroticism scale demonstrating a tendency to be more likely to be affected by emotional stimuli, individuals scoring high on the psychoticism scale have been commonly viewed as "toughminded" (e.g. Ciarrochi & Heaven, 2007; Eysenck & Eysenck, 1975; Stelmack, 1991). Indeed, a primary trait related to Eysenck's

psychoticism is *emotional coldness* (Eysenck & Eysenck, 1975; Strelau & Zawadski, 1997), and excessively high scores on the P scale are characterized by such behavioral characteristics as psychopathic, schizoid, schizoaffective, and schizophrenic (Eysenck, 1992; Strelau & Zawadski, 1997). Eysenck and Eysenck (1976) conceptualized individuals scoring high on the P scale as "cold, impersonal, lacking in sympathy . . . [and] unemotional" (p. 47). While not as extensive as the bodies of literature regarding the neuroticism and extraversion scales, some research does exist in attempt to verify such claims (see Weisberg, 2016 for review). Relevant to this study, research by Rawlings and Leow (2008) demonstrated a tendency for individuals scoring high on the P scale to enjoy music that is unsettling or boring, as well as a tendency to exhibit negative emotional responses to music considered by others to be relaxing and exciting.

METHOD

Participants

The participants in this study were 173 undergraduate students currently enrolled in a 2000-level psychology course (i.e. 2001, Introductory Psychology; 2003 Child Psychology; 2005 Adolescent Psychology; 2078, Developmental Psychology) at the University of Louisiana at Monroe (ULM). In terms of university classification, of the participants, 42.8% were freshmen, 34.1% were sophomores, 15.0% were juniors, and 8.1% were seniors. Of the participants, 78.0% were female and 21.4% were male; 0.6% (i.e. one case) of the demographic data regarding sex is missing due to participants' choosing to not provide this information. Disregarding the missing data for ethnicity (0.6%), approximately 56.6% of participants identified themselves as White (Caucasian), 31.2% Black/African American, 2.3% Hispanic, Latino, or Spanish, 6.4% Asian, and 2.9% responded with "Other race or origin". Ages of participants ranged from 16 to 36 with a mean of 19.73 and a standard deviation of 2.063.

Materials

Consent form. The consent form (see Appendix A) provided to participants prior to beginning study procedures contained all contact information required to reach the experimenter or the experimenter's major professor. Participants were asked to sign this document and return it to the researcher. This document will be kept in the experimenter's records for the duration of time indicated by the APA.

Demographic questionnaire. The demographic questionnaire (see Appendix B) utilized in this study consisted of a series of items designed to gather general participant information—this included school classification, sex, ethnicity, age, and ACT or SAT score (only ACT scores were included in the permanent data record for analyses; current procedures recommended on The College Board website (www.collegeboard.org) were followed in converting reported SAT scores to ACT scores). Participants were instructed that response to these items was, of course, voluntary, and that they could freely leave any of the items unanswered without repercussions.

Musical stimuli. The researcher utilized a small subset of the aforementioned Vieillard et al. (2008; copyright Bernard Bouchard) musical excerpts as the mood-inducing musical stimuli in this study. There were 56 total musical excerpts developed by Vieillard et al., and these 56 excerpts were divided into four groups of 14 musical clips based on the emotion the clip was found to express (i.e. happy, sad, scary, peaceful). "Happy" excerpts were composed in a major key with fast tempo; "sad" excerpts were composed in a minor key with slow tempo. "Scary" excerpts were composed with intermediate tempo and minor chords on the third and sixth degree, resulting in many "out-of-key" notes and an "odd" or "eerie" sound. "Peaceful" excerpts were composed in a major key with a slow-to-intermediate tempo. Vieillard et al. (2008) tested each excerpt for its perceived valence (i.e. intrinsic attractiveness or averseness) and arousal values based on large sample sizes. Each musical clip has an assigned average value for valence, arousal, and efficiency of expression of the intended emotions (i.e. happy, sad, scary, and peaceful). Permission to utilize the excerpts in research (with acknowledgements of the

copyright, Bernard Bouchard, 1998) is provided in a PDF document included inside the zipped downloadable file containing the musical excerpts (see Appendix C).

Word analogies. One hundred word analogies, each with one incomplete word pair (along with the associated correct responses), were used in this study (Dermott, Gade, McLean, Recco, & Schultz, 2002). Dermott et al. (2002) ordered analogies in terms of increasing difficulty (from a difficulty consistent with high school entrance exams to a difficulty consistent with the Miller Analogies Test, or MAT) as readers advance through chapters, and analogies utilized in this study were carefully selected from various chapters differing in difficulty.

Word analogy presentation. Word analogies were converted to a formatting appropriate for PowerPoint slides (on a solid white background with large, easily visible black font for text; see Appendix D for examples, albeit not to-scale); each analogy was presented in the format: "puppy : dog :: kitten : ________", with four possible responses designated in multiple-choice fashion (e.g. A, B, C, or D). Analogies were presented to participants through the utilization of the classroom's projector system and were viewable on two projector screens (one located on opposite sides of the classroom as to be better viewed by students sitting on either side of the classrooms). Each slide containing a word analogy was programmed to advance immediately following the end of the musical excerpt embedded into the slide (after 13.00 seconds).

Personality questionnaire. The Eysenck Personality Questionnaire (EPQ-R; Eysenck & Eysenck, 1975), though originally developed for utilization in psychopathological research, has been the frontrunner in the field of psychology (specifically, in personality research) for many years. Though currently not as popular in

comparison with the more-contemporary five factor model of personality, many researchers still continue to find the EPQ-R to be more valid than the five factor model (Block, 1995; Draycott & Kline, 1995). In 1985, Eysenck, Eysenck, and Barrett developed a short form of the EPQ-R for use among adults and when time is limited; the EPQ-R-S consists of 48 total items (each scale, psychoticism, extraversion, neuroticism, and the lie scale, consisting of 12 items). Reliabilities for males and females (respectively) are reported as 0.62 and 0.61 for psychoticism, 0.88 and 0.84 for extraversion, 0.84 and 0.80 for neuroticism, and 0.77 and 0.73 for the lie scale (Eysenck et al., 1985; Francis et al., 1992). The EPQ-R-S—while not utilized to the great extent such as in the case of the EPQ or EPQ-R—has been utilized in a variety of studies when time is limited (see such studies as Raine & Manders, 1988; Francis & Pearson, 1988; Lester, 1987). In this study, because time was limited (each class period in which data was collected lasted only seventy-five minutes), the EPQ-R-S was utilized to determine the reported levels of psychoticism (P), extraversion (E), neuroticism (N) for each participant. The EPQ-R-S was presented to participants in paper-and-pencil format in the questionnaire packet following the analogy response sheets (see Appendix F for example of presentation and formatting).

Analogy difficulty rating response sheet. In *only* the first data collection session, a small subset of participants (n = 29) were asked to complete an analogy difficulty rating response sheet presented in paper-and-pencil format (see Appendix H) by rating the difficulty of each individual analogy on a Likert scale from 1 (lowest difficulty) to 5 (highest difficulty) immediately following completion of the EPQ-R-S. Instructions were provided at the top of the first page of the difficulty rating response

sheet: participants were asked to rate the level of difficulty of each analogy and to indicate their responses by circling the appropriate number (e.g. 1, 2, 3, 4, or 5).

Design

Mood-inducing music group—the true experimental independent (within-subjects) variable of this study—was divided into five levels (i.e. happy music, sad music, peaceful music, scary music, and white noise). This study is considered to be within-subjects, as participants responded to analogies in each of the five groups. Participants' responses to analogies were treated as a dependent variable and coded as either correct or incorrect. The EPQ-R-S was divided into the three personality traits (i.e. psychoticism (P), extraversion, (E), neuroticism (N)) and the lie scale; data was analyzed for potential correlation to the participants' number of correct responses to the analogies assigned to each of the five levels of the independent variable (i.e. mood-inducing music group). While neuroticism and psychoticism are, overall, the primary personality traits upon which to be focused in this study, extraversion and the lie scale was also analyzed for potential correlations to correct analogy responses in various mood-inducing music groups.

Because strong support has been provided for the utilization of the Vieillard et al. (2008) musical clips as normed (i.e. standardized) musical mood induction stimuli has already been demonstrated by researchers (Vieillard et al., as well as by "predecessor" studies to this research; see Hill, 2009; Hill & Palmer, 2010) as demonstrating the ability to musically induce the intended mood (e.g. happy, sad, peaceful, scary), the researcher did not feel it was necessary to include a self-report measure of mood (such as the SDFMS) in this study.

Procedure

Prior to beginning this study, approval was obtained from the Institutional Review Board (IRB) of ULM (see Appendix I for Request for Review submitted to ULM's IRB and Appendix J for Notice of Determination). All relevant ethical guidelines set by the American Psychological Association (APA) were followed throughout the duration of the experiment, as well as after the experiment (regarding confidentiality and anonymity). No personal information regarding participants (i.e. name, campus identification number) was included in the permanent data record. Individuals who participated in the study were provided with extra course credit in return for participation; individuals who chose *not* to participate in the study were provided an equivalent opportunity to earn equivalent credit by the course instructor. All information obtained from participants in this study will be kept in strict confidentiality for the duration of time required by the APA.

Prior to the experiment, one musical clip was selected from each mood-inducing music group (i.e. happy, sad, peaceful, scary) of the Vieillard et al. (2008) musical stimuli; selection of the specific musical clip for each emotion was based on Carlson's (2007) selection of these clips as best portraying the intended emotion for inclusion in discussion regarding auditory stimuli (specifically, in the Peretz Lab downloadable zipped file, clips g07, t04, a01, and p03 were utilized for happy, sad, peaceful, and scary emotions respectively). Additionally, a clip of white noise with a duration equivalent to that of the musical excerpts was utilized as a control group. Clips were embedded in the PowerPoint presentation presented to participants alongside the appropriate word analogies for each group (i.e. happy, sad, scary, peaceful, white noise). The order of the musical excerpt groups as presented on the PowerPoint analogy slides was consistent

(e.g. 1—happy, 2—sad, 3—peaceful, 4—scary, 5—white noise, then 6—happy, 7—sad, 8—peaceful, 9—scary, 10—white noise, and so on). Each clip was programmed to play for 13.00 seconds, after which the PowerPoint slide would automatically advance to the following slide. Musical excerpts were heard by participants through the classroom's public address (PA) system's speakers with volume set to a level that was easily audible for all participants.

Participants were tested in three data collection sessions located in three large university classrooms of 45, 58, and 70 students; random assignment of students to mood-inducing music groups was not required, as the design of this study is within-subjects. Prior to the experimental data collection, the researcher designed the PowerPoint presentation (with a total of 102 slides), with one slide containing instructions to be presented to the participants and one slide containing an example analogy; see Appendix G); the remaining 100 slides consisted of the 100 analogies with the Vieillard et al. (2008) musical clips embedded. For the first classroom data collection, the professor of the course was originally present in the classroom and spoke briefly with the students regarding the reason for the researcher's presence; the professor then left the room. The specific dates of the latter two classroom data collection sessions were specified to participants as being optional—attendance was only needed if one wished to receive extra course credit, and, if the student did not wish to attend the data collection session, an equivalent opportunity for extra course credit was provided; professors of the courses were not present for either of the latter two data collection sessions.

Despite the fact that the researcher's monitor view being displayed to the participants via the classroom's projector system—because the musical clips were

already embedded into the PowerPoint presentation (and because they were presented in a consistent, nonrandom order)—there was no need to obscure the file names of the musical excerpts with random naming procedures. At the time participants began entering the classrooms, the first slide of the PowerPoint presentation—the “Instructions” slide (see Appendix G)—was visible on the projector screens. After the time at which the class meeting normally began had passed, the researcher (or assistants, in the case of the first data collection session) began distributing the questionnaire packets (with the consent form being the first page of the packet). At this time, participants were again reminded that the current class meeting was optional and strictly for the earning of extra course credit. Participants were also reminded that their participation was entirely voluntary: students were reminded that they were free to discontinue participation at any time and were free to skip any item on the demographic questionnaire or EPQ-R-S to which they were not comfortable responding (without the loss of any due extra course credit for participation or any other repercussion). The purpose of the study (i.e. “to identify and examine the influence of music on task performance”) was also very briefly described to participants, and the participants were thanked for their consideration of participating in this study. Participants were then urged to read the consent form thoroughly and complete the at the information at the bottom (e.g. signature, date, course professor’s name, section number or regular class meeting time); following this information regarding the consent form, participants were asked to proceed to the demographic page and complete the demographic information (unless, of course, one felt uncomfortable with completing any of the items).

Following these verbal reminders and instructions, the researcher brought the participants' attention to the "Instructions" slide that was visible on the projector screens. Participants were informed they would be presented with a series of 100 analogies—each with one incomplete word pair—and were asked to read each analogy and its associated potential responses (i.e. words that could possibly complete the analogy; presented in multiple-choice format). As previously mentioned, participants were urged to indicate their selection by writing only the letter (e.g. A, B, C, or D) in the appropriate numbered blank on the analogy response sheet located in the questionnaire packet (due to the time limit on each analogy item). Participants were informed that they would be provided thirteen seconds to respond to each analogy (i.e. the slide containing the analogy would automatically advance after thirteen seconds, the length of each musical clip and the white noise clip).

Finally, the researcher displayed and discussed slide two of the PowerPoint presentation (the "Example Analogy" slide; see Appendix G). The example analogy provided was: "puppy : dog :: kitten : ________". This was explained to participants as being read as "Puppy *is to* dog *as* kitten *is to* ________". The four potential responses, rabbit (A), cat (B), rat (C), and fox (D) were also shown, with the correct response (cat (B)) in bolded typeface (and denoted at the bottom of the slide). After this example was presented, participants were informed that advancement to the next slide of the PowerPoint presentation would begin their time on the first (and subsequent) word analogy slides and were instructed to begin work on the first analogy when the first musical excerpt began to play.

After the aforementioned reminders, instructions, and example had been provided to the participants and participants were finished completing the consent form and demographic questionnaire (and after ensuring that participants were aware they should now begin responding to analogies), the researcher then advanced to the next slide and the analogy response phase of the experiment began. As previously mentioned, each of the 100 PowerPoint slides contained one analogies and its responses on a solid white background with easily readable black font. The musical excerpts were embedded into the slides and were programmed to automatically begin playing when the slide began visible; slides were programmed to automatically advance every thirteen seconds (which is equivalent to the length of the various music clips and the white noise clip). Beginning from the first PowerPoint slide containing a word analogy (slide three), the PowerPoint presentation ran for approximately twenty-one minutes.

Participants were provided with four pages (see Appendix E for example, again, not to-scale) consisting of two columns of numbered blanks (excepting the final page, which only contained one column of blanks for analogies number 87 through 100). Participants were urged to respond to analogies with only the corresponding letter (e.g. A, B, C, or D) for each analogy, as opposed to writing the word response in the blank (both due to the time constraint imposed on each analogy PowerPoint slide and to increased ease of scoring with such a method).

Once the PowerPoint presentation had reached its end (i.e. the participants had finished responding to the 100 incomplete word analogies), participants were instructed to continue on to the EPQ-R-S portion of the questionnaire packet and to read the instructions included at the top of the first page of the personality questionnaire (see

Appendix F for full instructions as presented to participants). The included instructions urged participants to carefully read each statement and check or fill the circle which best related to their feeling or opinion regarding the statement ("Yes" or "No"); it was noted that only one response should be selected for each item. The included instructions also informed participants that there were no "right" or "wrong" answers and reminded them that participation in the completion of the questionnaire was strictly voluntary—they were free to choose to discontinue participation at any time without loss of any due extra course credit. Finally, participants were again thanked for their time in participating in this research.

During the first data collection session *only*, a small subset of participants (n = 29) were asked to rate each individual analogy on a Likert scale from 1 (lowest difficulty) to 5 (highest difficulty) immediately following completion of the EPQ-R-S. The analogy difficulty rating response sheet was distributed along with the rest of the questionnaire packet (at the end of the packet) to approximately half of the students in the classroom; every other questionnaire packet that was passed to a participant included the difficulty rating response sheet. Instructions were provided at the top of the first page of the difficulty rating response sheet (see Appendix H for instructions as presented to participants, as well as an example of formatting). Participants were asked to rate the level of difficulty of each analogy and to indicate their responses by circling the appropriate number (e.g. 1, 2, 3, 4, or 5). These were, of course, subjective difficulty ratings; however, this procedure was implemented in attempt to negate the possibility of an extraneous variable in the form of difficulty. The means of the participants' overall rating of each group (i.e. happy, sad, peaceful, scary, white noise) were 43.68 (happy),

43.24 (sad), 48.96 (peaceful), 49.04 (scary), and 48.04 (white noise)—a range of 5.8. Following this analysis of group means, the experimenter moved analogies between the groups with the highest overall difficulty ratings (i.e. happy and sad) and lowest overall difficulty ratings (i.e. peaceful, scary, and white noise) according to the sums of participants' individual Likert scale difficulty ratings for each item. Following rearrangement of analogies, the difficulty rating of the analogies that had been moved between groups were rearranged (according to their new item numbers) on a separate data editor spreadsheet and re-analyzed. Means of the difficulty ratings for the five groups following this rearrangement were: 49.67 (happy), 49.33 (sad), 49.26 (peaceful), 47.46 (scary), and 50.73 (white noise)—a range of 3.27. All analyses of difficulty ratings for analogies were conducted using SPSS 20.0 on Windows 10 Home.

The experiment concluded either when participants finished responding to the last item on the difficulty rating response sheet (for the first data collection session only) or when participants finished responding to the last item (number 48) on the EPQ-R-S (for the latter two sessions). Students were free to leave as they completed their questionnaire packets and after returning their questionnaire packets (including the consent form, demographic questionnaire, analogy response sheets, and paper-and-pencil form of the EPQ-R-S, as well as the difficulty rating response sheet in the first data collection session) to the researcher.

Statistical Analyses

All data for this research were analyzed through the utilization of SPSS 20.0 for Windows 10 Home. First, the difficulty ratings of each individual analogy provided by a small subset of participants during the first data collection session (n = 29) were analyzed

following the first data collection session, but before the latter two (refer to *Word analogies* subsection of the *Method* section for discussion). Following the two latter of the three data collection sessions (i.e. when the sample was complete), a repeated-measures (within-subjects) analysis of variance (ANOVA) was conducted, using mood-inducing music group (e.g. happy, sad, peaceful, scary, and white noise as control) as the independent variable and number of correct analogy responses as the dependent variable. This was done by first transforming the data through the computing of variables (i.e. “Happy”, “Sad”, “Peaceful”, “Scary”, “WhiteNoise”) comprised of the sums of the analogies that were assigned to each respective group (e.g. for “Happy”, “RATE1 + RATE6 + RATE11 + RATE16 . . . ”). This analysis was conducted with the intent to determine whether musically-induced mood produced a statistically significant difference in task performance between mood-inducing music groups (i.e. happy, sad, peaceful, or scary music or white noise). A pairwise comparison of estimated marginal means (with Bonferroni adjustment for multiple comparisons) was conducted to test hypotheses regarding the direction of the effects of mood-inducing music group. Additionally, bivariate (Pearson) correlations between the four EPQ variables (i.e. psychoticism, extraversion, neuroticism, and the lie scale) and the five computed variables comprised of the number of correct analogy responses based on mood-inducing music groups were computed.

RESULTS

Data from 173 participants revealed a significant effect for domain [one-way repeated measures ANOVA, Wilks' $\Lambda = 0.603$, $F(4, 169) = 27.856$, $p < 0.0001$, multivariate partial $\eta^2 = 0.397$]. Overall, the results from this statistical analysis indicate that musically-induced mood (i.e. happy, sad, peaceful, scary) did, in fact, have an effect on participants' ability to reason analogically (e.g. to correctly complete word analogies).

Pairwise comparisons with Bonferroni adjustment revealed that the number of correct analogy responses while listening to the "peaceful" music ($M = 12.52$, $SD = 3.274$) was significantly higher than the number of correct analogy responses while listening to the "happy" music ($M = 12.341$, $SD = 3.498$), which was significantly higher than the number of correct analogy responses while listening to the "scary" music ($M = 12.104$, $SD = 3.197$), which, in turn, was significantly higher than the number of correct analogy responses while listening to the "sad" music ($M = 10.74$, $SD = 3.942$). The mean scores for the four mood-inducing music groups all differed significantly from each other; additionally, the four mood-inducing music groups all differed significantly from the white noise control group ($M = 11.497$, $SD = 3.866$). These means are demonstrated visually in Figure 3.

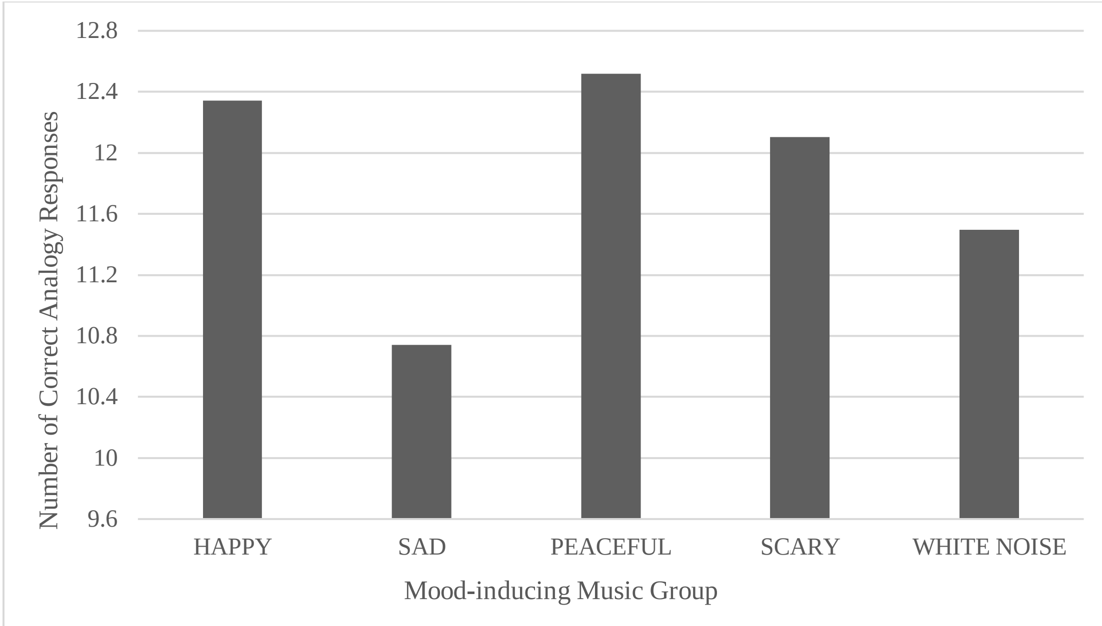

Figure 3. Mean number of correct analogy responses for each mood-inducing music group

In reference to specific hypotheses presented in this study regarding the direction of the effects of mood-inducing music group on participants' ability to perform on the analogical reasoning task, the pairwise comparison demonstrates a statistically significant (positive) difference between the Happy and White Noise groups (mean difference = 0.844, $p = 0.001$), suggesting that participants performed significantly better when responding to the incomplete analogies when listening to music in the Happy group than when White Noise was instead heard. This supports the hypothesis that "happy" music would facilitate increased ability to perform on a measure of analogical reasoning (in this study, word analogies). By contrast, the pairwise comparison demonstrates a statistically significant (negative) difference between the Sad and White Noise groups (mean difference = -0.757, $p = 0.005$), suggesting that participants performed more poorly when responding to the incomplete analogies when listening to music in the Sad group than when White Noise accompanied the analogy; this is in concordance with the hypothesis

that "sad" music would elicit decreased ability on the same measure of analogical reasoning. Furthermore—regarding the less explored musically-induced emotions of "peaceful" and "scary—a statistically significant (positive) difference between Peaceful and White Noise groups (mean difference = 1.023, $p < 0.0001$) was demonstrated. This does not support the hypothesis presented that the reduced state of arousal associated with relaxing music (i.e. "peaceful" music) would elicit decreased performance on the task; in fact, it suggests the opposite: participants performed better when listening to "peaceful" music than when the control of white noise was heard. Additionally, a statistically significant (positive) different was also demonstrated between the Scary and White Noise groups (mean difference = 0.607, $p = 0.024$): this suggests that "scary" music, too, elicits increased performance on the analogical reasoning task, which supports the hypothesis presented that the heightened state of arousal associated with the "scary" music would increase participants' ability to perform.

Finally, to test the hypotheses regarding Eysenck's neuroticism and psychoticism personality traits (as measured by the EPQ-R-S) and their potential effects on participants' ability to perform on the analogical reasoning task (due to the proposed effects of neuroticism and psychoticism on the strength of an individual's reactions to emotionally-charged stimuli), Pearson correlations between the four EPQ variables (i.e. psychoticism, extraversion, neuroticism, and the lie scale) and the five computed variables comprised of the number of correct analogy responses based on mood-inducing music groups were examined.

		HAPPY	SAD	PEACEFUL	SCARY	WHTNOISE
EPQ.PSY	Pearson Correlation	-.223**	-.173*	-.207**	-.060	-.130
	Sig. (2-tailed)	.004	.025	.007	.443	.094
	N	168	168	168	168	168
EPQ.EXT	Pearson Correlation	.009	-.112	-.121	-.091	-.063
	Sig. (2-tailed)	.904	.148	.119	.238	.418
	N	168	168	168	168	168
EPQ.NEU	Pearson Correlation	.040	.096	-.036	.090	.063
	Sig. (2-tailed)	.607	.213	.643	.249	.419
	N	168	168	168	168	168
EPQ.LIE	Pearson Correlation	-.200**	-.330**	-.193*	-.120	-.184*
	Sig. (2-tailed)	.009	.000	.012	.120	.017
	N	168	168	168	168	168

Figure 4. Correlations between EPQ-R-S scales and task performance based on mood inducing music group

** Correlation significant at 0.01 level (two-tailed)

* Correlation significant at 0.05 level (two-tailed)

As can be seen in Figure 4, there were no statistically significant correlations found between Eysenck's neuroticism and the computed variables of task performance based on mood-inducing music group (i.e. Happy, Sad, Peaceful, Scary, White Noise). This does not support the hypothesis that participants who reported high scores on the neuroticism scale would be more affected by the mood-inducing stimuli which would, in turn, exert a greater effect on their ability to perform on the cognitive task (as compared to individuals scoring low on the neuroticism scale). However, statistically significant negative correlations *were* found between Eysenck's psychoticism and the computed variables of Happy, Sad, and Peaceful. This is in support of the hypothesis that participants reporting high scores on the psychoticism scale would be less affected by the mood-inducing stimuli which, in turn, would exert a lesser effect on their ability to perform on the cognitive task (as compared to individuals scoring low on the psychoticism scale).

To further examine the demonstrated correlation between psychoticism and the computed variables, cases containing a psychoticism scale value greater than or equal to four (i.e. ≥ 4; the reported mean score on the P scale was found to be 2.26 with a standard deviation of 1.741: thus a P score ≥ 4 represented all the participants at or above one standard deviation above the mean for this trait) were selected and examined using a further examined. Data from 38 participants (reporting a P scale score ≥ 4) revealed a significant effect for domain [one-way repeated measures ANOVA, Wilks' $\Lambda = 0.592$, $F\ (4, 34) = 5.850$, $p = 0.001$, multivariate partial $\eta^2 = 0.408$]. A pairwise comparison with Bonferroni adjustment showed no statistically significant differences in correct analogy responses based upon mood-inducing music group: there were no significant differences between the mean scores in each mood-inducing music group, and no significant differences between the music groups and white noise control.

DISCUSSION

The sample of participants in this experiment is closely representative of the population of female and male students currently enrolled at ULM (i.e., as reported in the most recently updated enrollment statistics for ULM in terms of sex, there is a 1:3 ratio of male to female students, or 25% male, 75% female). Additionally, while the sample in this study is not representative of the general population in Monroe, Louisiana, as of the 2010 census information (United States Census Bureau, n.d.), it is fairly representative of the population of students enrolled at ULM in terms of ethnicity (i.e. 65.1% Caucasian, 21.8% African American, 2.2% Asian, 2.0% Hispanic, and 8.9% other; not all ethnicity options listed on the demographic questionnaire in this study were included in the most recently updated statistics regarding ULM's enrollment: specifically, American Indian or Alaskan and Native Hawaiian or Pacific Islander are not reported, and thus fall into the "Other" category). The mean age of participants included in this study—though relatively low when considered in conjunction with the relatively high enrollment of "nontraditional" students at ULM—is likely related to the relatively high percentage of freshman students included in the sample (likely due to introductory psychology classes being utilized for data collection).

A review of the current psychological literature indicates that an individual's mood can be manipulated through the use of emotionally-charged musical stimuli. Additionally, emotion and mood have been demonstrated by a variety of studies to affect levels of individuals' performance on a variety of cognitive measures. The primary focus

of this study was to re-examine and expand upon the current research base regarding the effects of music listening on an individual's ability to perform on specific cognitive tasks—in this study, whether musically-induced mood has the ability to affect an individual's performance on a measure of analogical reasoning (i.e. word analogies). The results of this study suggest that, overall, mood-inducing music (such as the clips developed by Vieillard et al.) exerts an effect on an individual's ability perform on a measure of analogical reasoning (in this study, word analogies). Participants consistently demonstrated an enhanced ability to respond to analogies correctly when the analogies were paired with "happy", "peaceful", or "scary" music as compared to when paired with white noise (i.e. the control of this experiment); conversely, participants demonstrated a suppressed ability to respond correctly when the analogies were paired with "sad" music as compared to white noise. This is good news for individuals who prefer to listen to music while working or studying (unless one prefers sad or depressing music): results of this study further support the hypothesis that listening to music has the ability to facilitate one's ability to perform on cognitive tasks (assuming it is not "sad" music). One might speculate that listening to music while working or studying may assist in more general ways, such as by masking ambient noise, reducing boredom throughout the duration of the activity, or increasing one's attention span (as suggested by Hargreaves & North, 1997).

While it is not known what, exactly, contributes to the emotional responses that humans experience in response to music, research *does* exist regarding the effects of various emotions on cognitive performance. Experimental studies have demonstrated that an individual's emotions can have a significant effect on the manner in which that

individual thinks, makes decisions, and solves problems. In this research, “happy” music was demonstrated as enhancing participants’ performance on the cognitive task of analogical reasoning as compared to a control of white noise. While there is not an expansive body of literature related to the effects of happy mood (or positive affect), there is enough research available to allow one to speculate. Evidence suggest that individuals who are happy—those who experience predominantly positive emotions—tend to be accomplished and successful across a variety of domains (Lyubomirsky, King, & Diener, 2005). Positive emotions—such as happiness—have been demonstrated as possessing the ability to promote a tendency in individuals to think, behave, and feel in a manner which promotes the building of one’s resources and involvement with “approach goals”, a type of performance goal (see Elliot & Thrash, 2002; Lyubomirsky, 2001). Performance goals (or “ability goals”) are described as the goal to either demonstrate one’s ability or to avoid demonstrating one’s lack of ability; performance-approach goals, specifically, are oriented towards the goal of demonstrating one’s ability (Midgley, Kaplan, & Middleton, 2001). Confidence, self-efficacy, effective coping with stressors and challenges, and originality and flexibility are commonly linked with positive emotion in the literature, and these characteristics encourage individuals to engage in active involvement with the pursuit of goals. Positive emotions such as happiness have been shown to produce a tendency to approach (as opposed to a tendency to avoid in reference to performance goals), as well as to promote the undertaking of new goals (Lyubomirsky et al., 2005).

Therefore, when individuals are happy, they demonstrate an increased likelihood of actively working towards goals while experiencing the happy mood (Lyubomirsky et

al., 2005). In the context of this study, the researcher is led to speculate that the participants' increased performance on the cognitive task when analogies were paired with the "happy" mood-inducing music could be explained by this increased tendency to actively work to achieve goals when experiencing positive mood—as well as increased involvement with performance-approach goals (i.e. increased feelings of wishing to demonstrate one's ability; in this study, on the analogical reasoning measure). Further research into the potential effects of "happy" music on cognitive tasks could potentially benefit from the exploration of a potential relation between performance-approach goals and musically-induced happy mood and this potential relationship's effects on various cognitive measures.

In contrast to "happy" music, "sad" music was shown to significantly decrease performance on the completion of the analogical reasoning task (as compared to a white noise control). The underlying neuroanatomical bases of both sad mood and cognitive processing exhibit a considerable amount of overlap as demonstrated by functional neuroimaging studies. Sad mood has been shown to influence activity in specific regions of the brain (e.g. the prefrontal and limbic regions; Davidson, Pizzagalli, Nitschke, & Putnam, 2002), and many of the same areas are also associated with cognitive functioning (for a review, see Chepenik, Cornew, & Farah, 2007). The demonstrated effects on cognitive performance of "sad" music may also be related to the effects on cognitive performance exhibited by patients coping with depression. Depression has been demonstrated to lower performance on measures of working memory (e.g. Harvey et al., 2004) and cognitive control—the process which regulates the needed attentional acuity to avoid errors (e.g. Rogers et al., 2004).

This researcher also speculated that the demonstrated effect of "sad" music may be related to rumination, which is often seen as a response to depressed or sad mood (e.g. Verhaeghen, Joorman, & Khan, 2005). Prior research has demonstrated a relationship between rumination and inflexibility in attention (Brinker, Campisi, Gibbs, & Izzard, 2013; Davis & Nolen-Hoeksema, 2000; Lo, Lau, Cheung, & Allen, 2012). Musical mood induction literature would likely benefit from the comparison of effects demonstrated by musically-induced "sad" mood on cognitive performance to the effects on cognitive ability demonstrated as linked to depression (e.g. working memory and cognitive control).

The results of this study unfortunately did not support the presented hypothesis regarding "peaceful" music—that the reduced state of arousal associated with relaxing (i.e. "peaceful") music would elicit decreased performance on the analogical reasoning task. However, the demonstrated increase in the ability to reason analogically while listening to "peaceful" music (as compared to a control of white noise) may still yield important information for advancement of the field of musically-induced mood. It should first be noted that, not only the hypothesis regarding "peaceful" music not supported, but an effect that was in the *opposite* direction was also demonstrated. Hill's (2009) analyses of data regarding the mood-induction efficacy of the "peaceful" and "scary" emotionally-charged music groups by Vieillard et al. (2008) suggested that, perhaps, the two groups do not consistently produce significantly different changes in mood in individuals. This researcher still believes (as did Hill) that it is likely too premature to make this inference despite the results of this study—further examination of the moods induced by the Vieillard et al. (2008) "peaceful" and "scary" clips is recommended.

One may speculate that the demonstrated increase in participants' performance while listening to "peaceful" music may be related to what has been called the "relaxation response" (see Galvin, Benson, Deckro, Fricchione, & Dusek, 2006). This "relaxation response" is characterized by such physiological changes as lowered heart rate, blood pressure, and respiration, as well as a general state of well-being. Many relaxation techniques (e.g. meditation, controlled breathing, or music relaxation) have been shown to not only reduce stress (e.g. Kaspereen, 2012), but to also improve various aspects of cognitive performance such as working memory and attention (Morrison & Lindsay, 1997). Furthermore, the addition of the appropriate type of music—specifically, "sedative" music, such as the "peaceful" Vieillard et al. (2008) excerpts—to various relaxation techniques has been shown to increase their effectiveness in reducing stress and, oftentimes, in increasing cognitive functioning (e.g. Kaspereen, 2012; Roden, Grube, Bongard, & Kreutz, 2013). Perhaps, then, the demonstrated increased ability to perform on the task while listening to "peaceful" music is related to the "relaxation effect" through the facilitation of enhanced working memory and attention.

When one considers the literature available regarding the effects of the "fight-or-flight" response in humans, the observed increase in performance in the Scary music group appears to make sense. Readers and researchers alike are likely familiar with this "fight-or-flight" response. It serves to activate the sympathetic nervous system and is characterized by physiological changes in heart rate, respiration, and blood pressure, among others. Additionally, activation of this response stimulates two endocrine systems related to stress response, one of which releases cortisol (a glucocorticoid known as the "stress hormone") and adrenaline (Ramsey et al., 2012). The impact of acute stressors on

general cognitive functioning has been proposed to follow an inverted-U-shaped curve: while small increases in glucocorticoids are known to result in enhanced hippocampus-mediated learning and memory, larger and more prolonged elevations are known to impair this functioning. This inverted-U-shaped relationship between level of glucocorticoids and general cognitive functioning has been demonstrated in both animals and in human studies. Studies with human participants have the ability to differentiate glucocorticoid effects on emotional—rather than neutral—information processing. In human studies, acute glucocorticoid elevations have been demonstrated to significantly increase memory for emotional information (Lupien, McEwen, Gunnar, & Heim, 2009). This researcher is led to speculate that the effects of musically-induced mood based on "scary" or "fearful" music would likely follow the same proposed inverted-U-shaped curve, with acute (i.e. short) exposures to "scary" music clips initially enhancing performance on various cognitive tasks (e.g. word analogies), but later impairing this same ability with more prolonged exposure. Further research into the effects of "scary" music on cognitive functioning could produce intriguing results, and would certainly benefit from the measurement of potential cortisol release (e.g. via the measurement of salivary cortisol; Kalman & Grahn, 2004) in response to emotional response to "scary" mood.

This researcher also examined the relationship between Eysenck's neuroticism and psychoticism traits and the strength of response to emotionally-charged stimuli (e.g. the Vieillard et al. (2008) musical excerpts), as well as the effects of this relationship on participants' ability to perform on the analogical reasoning task. Hill (2009) hypothesized that individuals scoring high on Eysenck's neuroticism scale would be affected more

strongly by emotional response to musically-induced mood than would individuals scoring low on the neuroticism scale. While Hill found no statistically significant differences between high scorers and low scorers on the N scale when listening to "happy" music, there was, in fact, a significant difference between high- and low-neuroticism groups when listening to "sad" and "scary" music (emotions which are generally considered to be negative, a phenomenon that is easily explained by a large body of research, e.g. Bradley & Mogg, 1994; Rusting & Larsen, 1997). As such, it was hypothesized in this research that individuals who reported high scores on the N scale would be more affected by the mood-inducing musical stimuli and would, thus, exhibit a greater effect on performance on the cognitive task. However, there were no statistically significant correlations between performance on the analogical reasoning task and scores on Eysenck's neuroticism scale demonstrated in this study. It is important to note that this does not necessarily contradict the findings of the Hill (2009) study, as Hill was examining the effects of high and low neuroticism on the mood-inducing ability of music—*not* the effects of these moods on some cognitive task.

On the other hand, individuals scoring high on the psychoticism scale have traditionally been viewed as "toughminded", cold, and unemotional (e.g. Eysenck & Eysenck, 1975; Eysenck & Eysenck, 1976; Stelmack, 1991). Therefore, it was hypothesized in this study that participants who reported high scores on the psychoticism scale would be less affected by the mood-inducing musical excerpts and, thus, the mood-inducing stimuli would exert a lesser effect on their ability to perform on the analogical reasoning task (compared to individuals reporting low scores on the P scale). Indeed, significant negative correlations between reported scores on the P scale and the Happy,

Sad, and Peaceful mood groups ($p = -0.004, -0.025$, and -0.007, respectively) were reported. In light of this finding, cases containing a P scale score greater than or equal to four (i.e. ≥ 4; refer to Results section for explanation as to why this value was used) were selected in the data and were further analyzed through the utilization of a repeated-measures ANOVA. A pairwise comparison with Bonferroni adjustment showed no statistically significant differences in correct analogy responses based upon mood-inducing music group: there were no significant differences between the mean scores in each mood-inducing music group, and no significant differences between the music groups and white noise control. This suggests that participants scoring high on the P scale were generally less affected by the musical stimuli.

A variety of inferences can likely be amassed in response to these findings. This researcher speculates that the heightened effect of the "scary" music may be related to the previously discussed findings of Rawlings and Leow (2008): individuals scoring high on the P scale exhibit a tendency to *enjoy* music that is unsettling (e.g. the "scary" music), as well as a tendency to exhibit negative emotional responses to music considered by others to be relaxing and exciting (e.g. the "happy" and "peaceful" music). With these findings considered, it may be the case that individuals scoring high on the psychoticism scale found the "scary" music to be more enjoyable than the "happy" and "peaceful" music. Therefore, the *intended* emotional response associated with the Happy, Peaceful, and Scary mood-inducing music groups would be affected, and the effect of the emotional response on performance would also be altered. However, further research is certainly needed to better explore the relationship between mood-inducing musical stimuli, level of performance on cognitive tasks, and high scores on Eysenck's psychoticism scale.

As previously mentioned, one of the primary concerns with music research has historically been its disorganized nature—specifically, the utilization of widely varied methodology and stimuli. However, the development of the musical excerpts by Vieillard et al. (2008) for use as normed stimuli in music research constituted a giant step toward a more efficient, effective, and comparable body of research in the field of music psychology. The results of this study further support the utilization of the Vieillard et al. musical excerpts for research on music and emotion, especially for research regarding musically-induced mood and its potential effects on cognitive performance. Future research studies utilizing the Vieillard et al. musical clips would likely benefit from the use of neural imaging (e.g. fMRI) or other physiological measures to detect the presence of emotional responses (as opposed to self-report methods). The Vieillard et al. musical excerpts are believed by this researcher to be vital to the furthered understanding of the effects of music on the human mind. Furthermore—together with the Hill (2009) study regarding the effects of neuroticism on musically-induced mood—the results of this study serve to highlight the potential importance of personality traits (such as Eysenck's psychoticism) in research on such phenomena as musically-induced mood. Such findings may be a "foot in the door" to accessing a wide avenue of future research regarding the potential relationship between musically-induced mood, emotional response, and performance on various cognitive tasks.

Future research regarding the effects of musically-induced mood on measures of analogical reasoning (and other measures of cognitive task performance) may also benefit from the utilization of samples which are more representative of the general population than that included in this study. It seems logical that intellect may play an underlying role

in this study when one considers the inclusion of measures of analogical reasoning on standardized “college readiness” exams such as the ACT and SAT. Therefore, a sample based solely upon college students may present differing results from a sample based upon the general population.

APPENDIX A

CONSENT FORM

Study Title: Music and Task Performance

Study Site: ULM Library

Purpose of Study: The purpose of this study is to identify and examine the influence of music on measures of task performance.

Participant Description: ULM students enrolled in 2000-level Psychology courses.

Study Procedures: Participants will be asked to fill out a two-part questionnaire and a measure of task performance. This will take from 45 to 60 minutes.

Benefits: Students participating in this study (beyond that which is a course requirement) may have the opportunity to receive extra course credit. If you choose not to participate in this research, other equivalent opportunities to earn equivalent credit will be provided by the course instructor. Participants will also attain the knowledge that they have assisted in advancing the scientific understanding of psychology.

Risks/discomforts: There are no known risks, physical or psychological, to participants. Stress associated with this study should be no more than that experienced in a normal classroom setting.

Right to Refuse: Participation is voluntary. Participants can refuse to participate and can discontinue their participation at any time—without penalty or loss of benefits to which they are otherwise entitled. If you choose not to participate in this research, other equivalent opportunities to earn equivalent credit will be provided by the course instructor.

Privacy: The privacy of participants is strictly protected. Your name and identity are kept completely confidential. Participants' names are not recorded on permanent data records, and all individual data is kept anonymous. Data is reported only in collective (group) form, and no individual data is ever reported.

Contact: Dr. Palmer (Phone: 318-342-1345; Email: palmer@ulm.edu)
Christian Johnston (Email: johnstcd@warhawks.ulm.edu)

The purpose of this project has been explained to me. I understand that my participation is completely voluntary. I understand that my data will be kept confidential and anonymous.

Signature ____ Date ___________________

Please print your name ____

To ensure you receive your extra credit:

PSYC 2001/2003/2005/2078 Professor's Name _______________________________________

When does your class meet? (Or Section Number) ____________________________________

APPENDIX B

DEMOGRAPHIC QUESTIONNAIRE

Year:

- ☐ **Freshman**
- ☐ **Sophomore**
- ☐ **Junior**
- ☐ **Senior**
- ☐ **Not applicable**

Sex:

- ☐ **Male**
- ☐ **Female**

Date: _____/_____/_____

Age: _______

ACT Score: _______ or **SAT Score:** _______

Ethnicity:

- ☐ **White**
- ☐ **Black/African American**
- ☐ **Hispanic, Latino, or Spanish**
- ☐ **American Indian or Alaska Native**
- ☐ **Asian**
- ☐ **Native Hawaiian/Other Pacific Islander**
- ☐ **Other race or origin**

Case #: _______________
(For researcher use only: please do not write in this blank.)

APPENDIX C

PERMISSION PROVIDED TO UTILIZE THE VIEILLARD ET AL. (2008) MUSICAL EXCERPTS

Permission Statement Included in PDF format inside Downloadable Zipped File

Containing Musical Stimuli

These musical excerpts are protected by copyrights belonging to Bernard Bouchard (Copyright, Bernard Bouchard, 1998). This material may be used for the purpose of publication and of communication with acknowledgement as property of the rightful author (Copyright, Bernard Bouchard, 1998).

APPENDIX D

EXAMPLES OF ANALOGY ITEMS CONVERTED TO POWERPOINT SLIDES TO BE PRESENTED TO PARTICIPANTS

1. volume : ________ :: stanza : poem

a. measure
b. pint
c. encyclopedia
d. kitchen

47. tricycle : wheel :: ________ : month

a. August
b. day
c. perennial
d. trimester

APPENDIX E

EXAMPLE OF PARTICIPANT ANALOGY RESPONSE SHEET

27. ____________	**42.** ____________
28. ____________	**43.** ____________
29. ____________	**44.** ____________
30. ____________	**45.** ____________
31. ____________	**46.** ____________
32. ____________	**47.** ____________
33. ____________	**48.** ____________
34. ____________	**49.** ____________
35. ____________	**50.** ____________
36. ____________	**51.** ____________
37. ____________	**52.** ____________
38. ____________	**53.** ____________
39. ____________	**54.** ____________
40. ____________	**55.** ____________
41. ____________	**56.** ____________

APPENDIX F

EXAMPLE OF INSTRUCTIONS AND FORMATTING OF THE EPQ-R-S AS PRESENTED TO PARTICIPANTS

Please read instructions before beginning.

Instructions: Please read each question carefully and check or fill the circle which best relates to your feeling or opinion. Please choose only <u>one</u> response for each item. There are no right or wrong answers. Your participation is strictly voluntary, and you may choose to discontinue at any time. Thank you for your time in participating in this research.

1.	Does your mood often go up and down?	Yes ○	No ○
2.	Do you take much notice of what people think?	Yes ○	No ○
3.	Are you a talkative person?	Yes ○	No ○
4.	If you say you will do something, do you always keep your promise no matter how inconvenient it might be?	Yes ○	No ○
5.	Do you ever feel "just miserable" for no reason?	Yes ○	No ○
6.	Would being in debt worry you?	Yes ○	No ○
7.	Are you rather lively?	Yes ○	No ○

APPENDIX G

INSTRUCTIONS PROVIDED TO PARTICIPANTS VIA POWERPOINT PRESENTATION

Instructions

You will be presented with a series of analogies, each with one incomplete word pair. For each analogy:

Please read the analogy and its associated multiple-choice options and select the word that you feel best completes the analogy. Indicate your selection by writing the letter (e.g. **A**, **B**, **C**, or **D**) that corresponds to your choice in the appropriate blank on the Response Sheet located in your questionnaire packet.

You will have approximately 13 seconds to respond to each analogy.

Example Analogy

Analogies will be presented in the following form:

puppy : dog :: kitten : ________

a. rabbit

b. **cat**

c. rat

d. fox

This is read as: "Puppy *is to* dog *as* kitten *is to* ________".

Of course, the best answer for this analogy is cat.

APPENDIX H

EXAMPLE PAGE OF THE RATING DIFFICULTY SHEET

Instructions: Please rate the level of difficulty of each analogy on a scale of one (lowest) to five (highest). Indicate your rating by circling the appropriate number (e.g. **1**, **2**, **3**, **4**, or **5**) for each item.

1. volume : ___ :: stanza : poem 1 2 3 4 5 low high	**8. mouse : ___ :: flash : camera** 1 2 3 4 5 low high
2. moccasin: snake :: ___ : shoe 1 2 3 4 5 low high	**9. shallot : ___ :: scallop : mollusk** 1 2 3 4 5 low high
3. bulky : streamlined :: ___ : neat 1 2 3 4 5 low high	**10. reconcile : fight :: ___ : procrastinate** 1 2 3 4 5 low high
4. moisten : ___ :: cool : freeze 1 2 3 4 5 low high	**11. hint : ___ :: whisper : shout** 1 2 3 4 5 low high
5. rein : horse :: control panel : ___ 1 2 3 4 5 low high	**12. rook : chess :: ___ : badminton** 1 2 3 4 5 low high
6. scrub : wash :: sob : ___ 1 2 3 4 5 low high	**13. chatter : talk :: flutter : ___** 1 2 3 4 5 low high
7. ___ : peace :: lion : courage 1 2 3 4 5 low high	**14. Grim Reaper : death :: Cupid : ___** 1 2 3 4 5 low high

APPENDIX I

REQUEST FOR REVIEW FORM SUBMITTED TO ULM'S IRB

IRB 703

University of Louisiana at Monroe
Institutional Review Board

REQUEST FOR REVIEW
PROJECTS USING HUMAN SUBJECTS

Received by ULM'S
Office of Sponsored
SEP 29 2016
Programs and Research

Principal Investigator: Jack A. Palmer

Email: palmer@ulm.edu College: CBSS Dept: Psychology

Office Phone: 318-342-1354

(Principal Investigator must be a ULM employee, student investigators are to be listed under collaborators)

Collaborators: Christian D. Johnston: johnstcd@warhawks.ulm.edu

Project Title: *Musical Mood Induction: Effects on Analogical Reasoning and Critical Reading Ability*

Starting Date: October 15th, 2016 Termination Date: May 15th, 2017

Briefly describe the participants:

Total number 300

Age 18-80

Gender Male & Female

Ethnic minority All

Source of participants University of Louisiana Undergraduate Students

Will the data derive from existing records on the participants? ☐ YES ☑ NO

If yes, will the data be recorded in a fashion that will prevent the subjects from being identified? Please explain.

Will any of the participants be classified under the Special Consideration Categories:
Check all that apply

- ☐ Children Ages: ____
- ☐ Cognitively Impaired
- ☐ Blind Individuals
- ☑ None
- ☐ Non-English speaking individuals
- ☐ Students
- ☐ Prisoners
- ☐ Pregnant or lactating women

Site of data collection University of Louisiana at Monroe
Letter of support from project site must be included

Purpose and Significance of Project (if more space is needed attach separate typewritten document):

The purpose of this study is to identify and examine the effects of acute, musically-induced mood states on measures of an individual's analogical reasoning and critical reading ability. Additionally, two of Eysenck's proposed personality traits--neuroticism and psychoticism--will be explored in relation to the strength of the musically-induced mood states.

23 pgs

09-29-16P03:36 RCVD LF

Effective 7/1/2009
All other forms are obsolete

Summary of Experimental Plan (if more space is needed attach separate typewritten document):

After providing informed consent, participants will first respond to demographic items and complete several psychological self-report instruments: the Eysenck Personality Questionnaire Revised Short-scale (EPQ-R-S), the Emotional Intensity Scale (EIS). Participants will then be asked to quietly listen to a sample of either "happy" or "sad" music clips for a period of five minutes; these varying musical clips were developed by Vieillard, Peretz, Gosselin, and Khalfa (2008) in four groups of 14 clips (56 total clips) which have been shown to align with four intended emotions: "happy", "sad", "peaceful", and "scary". While the music continues, participants will be presented with a series of measures designed to assess analogical reasoning (word analogies) and critical reading ability (sentence completion and word association items). Samples of these items have been included in the sample questionnaire packet submitted alongside this proposal. Participants will then complete the Semantic Differential Feeling & Mood Scale to ensure the intended mood has been induced.

Explain how participants will be recruited

Participants will be recruited from undergraduate-level psychology courses at the University of Louisiana at Monroe. Specifically, instructors in the psychology department who are currently teaching 2000-level undergraduate psychology courses will be asked to inform their students of the opportunity of participation in the present study. Students in ULM courses may be offered the opportunity to participate in various research projects in order to fulfill requirements of a course or to receive extra credit for a course.

Statement of Possible Risks and Benefits:

To the researchers' knowledge, there is no risk associated with this research. Participants will listen to music clips and respond to a packet of questionnaires, as well as some basic measures of analogical reasoning. Stress associated with this study should be no more than that experienced in a normal classroom setting. Students participating in this study (beyond that which is a course requirement) may have the opportunity to receive extra course credit; equivalent extra credit opportunities will be provided by the course instructor to students who choose not to participate in the present study. Participants will also attain the knowledge that they have assisted in advancing the scientific understanding of psychological phenomena, specifically those related to musical mood induction.

Describe your methods of protecting the participants privacy and confidentiality of information

The privacy of participants will be strictly protected. Participant names and identities will be kept strictly confidential. Participants' names will not be recorded on permanent data records and all individual data will be kept anonymous. Data will be reported only in collective group form and no individual data will ever be reported.

Effective 7/1/2009
All other forms are obsolete

Informed Consent Describe the method by which informed consent will be obtained and attach a sample copy of any document which will be used to obtain or record informed consent.

Informed consent will be obtained through the utilization of a printed informed consent form which will include such information as: study title, study site, purpose, participant description, a short description of the study procedure, a list of potential benefits and risks, and information regarding the students' right to refuse and privacy, as well as contact information for both the principal investigator and collaborator.

Previous Experience of Investigator Related to this or Similar Projects:

The principal investigator, Dr. Jack A. Palmer, has over 28 years of experience conducting psychological research with human participants.

*****

REQUESTED BY:	**APPROVED BY:**
Principal Investigator	Insert title (supervisor of PI)
9/29/16	
Name: Dr. Jack A. Palmer Date	Name: Dr. Pamela Saulsberry Date 9/29/16

Collaborator

9/29/2016

Name: Christian D. Johnston Date

APPENDIX J

NOTICE OF DETERMINATION FOR PROJECTS USING HUMAN SUBJECTS

The University of Louisiana at Monroe

Institutional Review Board

Notice of Determination for Projects using Human Subjects

Protocol ID#:	703 -2016
Principal Investigator:	Dr. Jack Palmer
Collaborator(s):	Christian Johnston
Project Title:	Musical Mood Induction: Effects on Analogical Reasoning and Critical Reading Ability
Date Approved:	10/17/2016
Expiration Date:	10/16/2017

☑ 1) In accordance with the ULM Policy for the Protection of Human Subjects, the ULM Institutional Review Board reviewed and APPROVED this project on the above date. Note: The project is subject to continuing review and any conditions listed in the comments section below.

- ☐ a. This project has received FULL COMMITTEE REVIEW.
- ☑ b. This project has received EXPEDITED REVIEW.
- ☐ c. This project is EXEMPT based on the following part and section(s) of the ULM Policy for the Protection of Human Subjects:

Exempt:

☐ 2) In accordance with the ULM Policy for the Protection of Human Subjects, the ULM Institutional Review Board reviewed this project and has determined that this project does not meet IRB standards and is therefore DEFICIENT for the reasons listed in the comments section below.

Comments:
This project's "APPROVED" start date is determined according to the date listed above in this notification. Any research conducted, prior to this date, must cease and all data collected destroyed.

Thank you for your submission. Please contact the Office of Sponsored Programs and Research if you require any further assistance.

Gregory W. Smith

Gregory W. Smith, Pharm. D.
Chair, ULM's IRB

cc: PI's Department Head
IRB protocol file

Monday, October 17, 2016

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